Building NOAA's Environmental Real-time Observation Network

Site Installation Plan

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U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service

Signature/Approval Page

Building NOAA's Environmental Real-time Observation Network
Site Installation Plan

Approved:

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Date: _______________	**Date: _______________**

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service

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1 Introduction

The installation procedures in this document are intended to ensure a uniform station configuration and to maximize safety, data quality, and equipment reliability across NOAA's Environmental Real-time Observing Network (NERON) — formerly known as the Modernization of the Cooperative Observer Network. The intent is to provide NWS Management and external organizations contracted to install NERON stations with explicit and clear instructions about how the NERON Project Office expects the equipment and sensors to be installed. The goal is to reduce confusion and cost, resulting in a world-class climatological and meteorological observing network.

This document contains diagrams showing configurations for sites with 2 different plot sizes and for sites with a single 3-meter tower section, or a full-height tall tower. The 24-foot-by-24-foot plot will accommodate a 3-meter tower, while the 32-foot by-32-foot plot will accommodate either the 3-meter tower (with room for future expansion) or the tall (10-meter) tower and the associated guy wiring needed for the tall tower. While the configurations specified are the goal, situations will occur when the installer must deviate from the ideal configuration. In these cases, all deviations must be documented photographically and on the 'as-built' drawing included in the appendix of this document.

Detailed instructions also are included on installing and calibrating the GEONOR precipitation gauge, installing the operational prop vane wind sensor, and installing soil moisture/temperature sensors. The appendix includes checklists for equipment and materials used in each kind of station, installation checklists for each kind of station, a precipitation/gauge calibration worksheet for the GEONOR sensor, an as-built drawing form, and a station installation metadata form. The equipment and materials checklists are designed to be aids in acquiring and packing equipment for individual installation trips. The installation checklists are intended as an aid in double-checking that all required installation tasks have been completed at each station; these forms must be submitted to the NERON Project Office as certification to that effect within one week of installation. The station installation metadata form is official documentation for the NERON Project Office of the specific equipment installed and the configuration of each site and station.

2 Procedure for a Site with a 3-Meter Tower on a 24-by-24-foot plot

A site chosen for the installation of a 3-meter tower may or may not be upgraded to a tall-tower site in the future. However, if the site has been determined not to have adequate exposure for the installation of an operational wind sensor or the installation of soil moisture sensors and will not be expanded to a site with a tall tower, a 24-by-24-foot plot size may be used. The minimum plot size is 24-by-24 feet

The following figures illustrate the proper placement of equipment in a 24-by-24-foot plot (Note: Refer to Figures 1 through 3 below for the positions and configuration of the equipment). In addition, these procedures cover installation for potential sensors that could be installed at a 3-meter tower site. Not all potential sensors will be installed at every site.

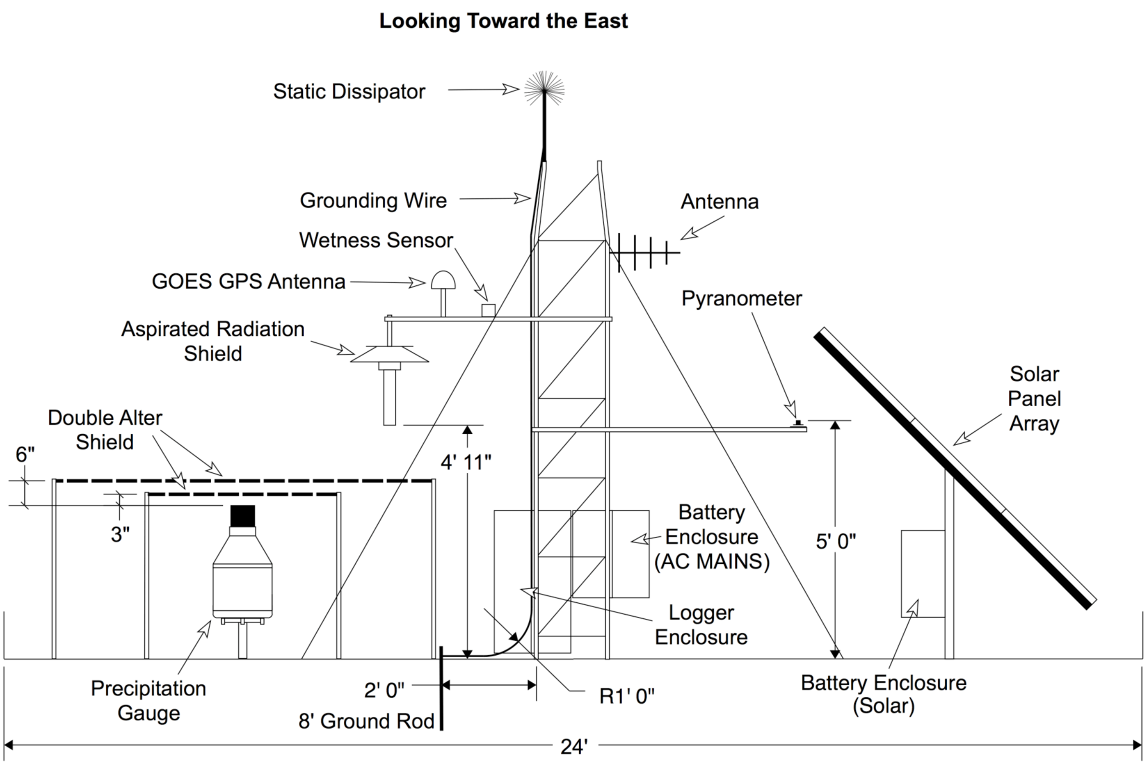

Figure 1. Profile view of a station plot that measures 24-by-24 feet and has a 3-meter tower.

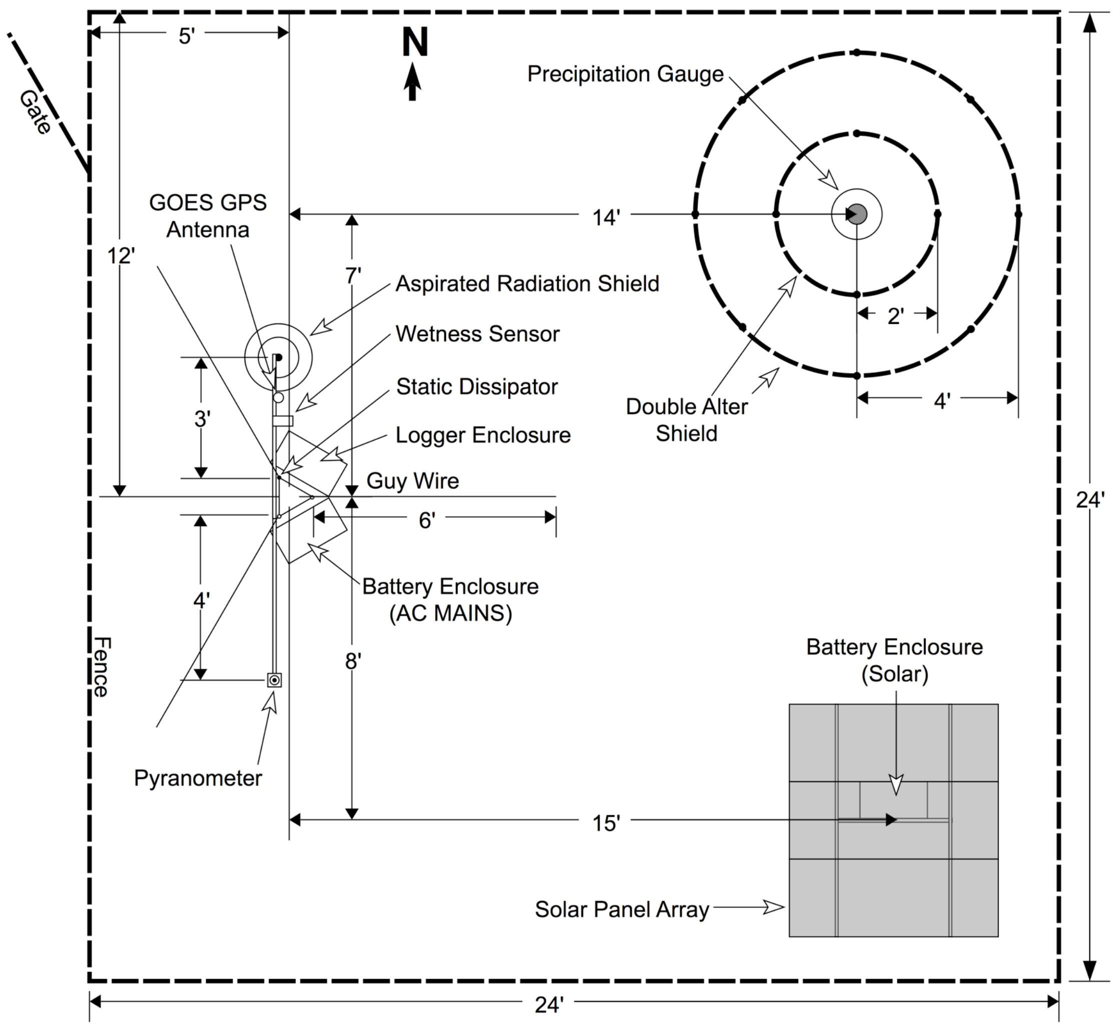

Figure 2. Plan view of a station plot that measures 24-by-24 feet and has a 3-meter tower.

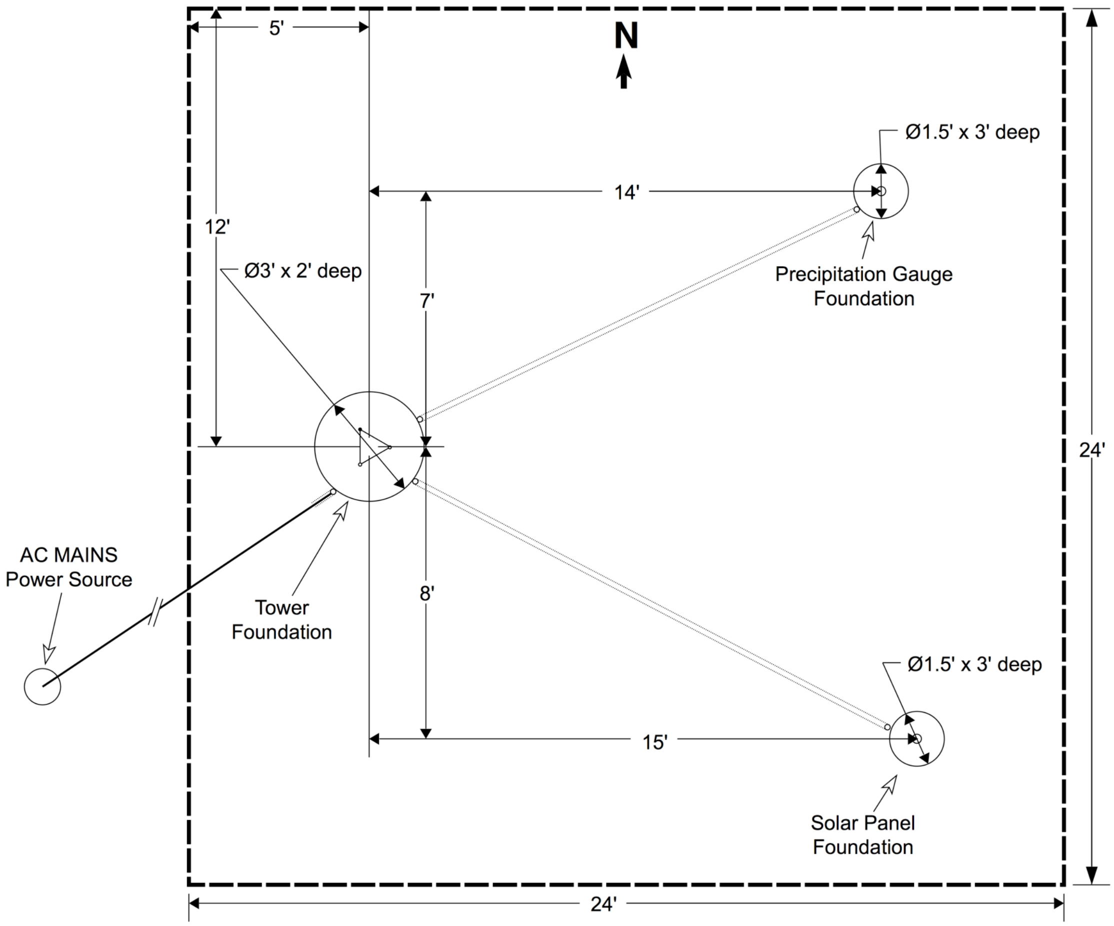

Figure 3. Plan view of a station plot that measures 24-by-24 feet showing foundation and conduit placement.

Note: All compass directions referred to in these procedures are referenced to true north.

1. Obtain verification that the site is clear of underground utility lines or, if any are present, that their locations are marked and they can be avoided before digging.
2. Obtain information on the depth of the frost line if concrete foundations will be installed.
3. Complete all pre-installation photos, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. In addition, as installation progresses, document deviations from the standard configuration and any other notable findings, as described in the photographic documentation section.
4. Measure and mark the extent of the plot, assuming the stake placed by the surveyor represents the exact center of the plot.
5. If necessary, cut the vegetation in the plot as low as possible to make installation easier; plan for its maintenance at this level.

6. Install the tower base foundation, as shown in Figure 3,with the center of the tower 5 feet east and 12 feet south of the northwest corner of the plot. Install the tower base so that the tower will tilt to the west, with one of the flat tower sides facing due west (i.e., the side extends north-south). If a concrete foundation is necessary, take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Install the concrete base for the tower as illustrated in Figure 3.
7. Install the concrete foundation for the precipitation gauge 7 feet north and 14 feet east of the tower, as shown in Figure 3. The precipitation gauge must be centered at the location shown in Figure 3. Dig a hole 1.5 feet in diameter and 3 feet deep, and insert a cylindrical concrete form into the hole. Drive a 2" pipe that is long enough to extend from the bottom of the hole to the precipitation gauge mount into the ground at the center of the hole. Verify that the pipe is exactly vertical and centered in the concrete form, and secure it in place at the top of the hole with a jig. Take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Fill the concrete form with concrete and allow it to cure.
8. Install the solar panel mast foundation (if a solar panel is to be used) at a distance 8 feet south and 15 feet east of the tower, as shown in Figure 3. Dig a hole 1.5 feet in diameter and 3 feet deep, and insert a cylindrical concrete form into the hole. Drive a pipe of the proper size for the solar panel mount and that is long enough to extend from the bottom of the hole to the solar panel array mount into the ground at the center of the hole. Verify that the pipe is exactly vertical and centered in the concrete form, and secure it in place at the top of the hole with a jig. Take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Fill the concrete form with concrete and allow it to cure.
9. If the tower will not be free-standing (i.e., either no concrete foundation or a concrete foundation that is shallower than 2 feet deep or not resting on bedrock), select guy wire anchors appropriate to the soil type at the site, as specified in Table 3 on Page 32 in Section 5 of this manual.
10. Mark the positions of the guy wire anchors, using a jig that fits on the three tower-base leg mounts (see Figure 4 below). The jig should have a string attached to the center of the jig that extends 6 feet past the tower leg. Pull the string taut and position it so that it passes directly over the center of the tower leg to which each guy wire will be attached to mark each of the three anchor positions. Install the guy wire anchors into the ground at the marked positions.

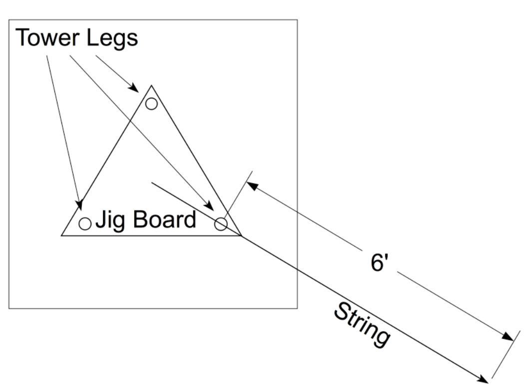

Figure 4. Diagram of a jig used to mark guy wire anchor positions for a 3-meter tower.

11. Drive the 8-foot, copper-clad steel ground rod into the ground 2 feet due north of the northwest leg of the tower. Leave 3 inches of rod above ground level to allow attachment of ground wires.

    Note: If it is not possible to drive the 8-foot ground rod fully into the ground in rocky soil or where the bedrock is shallow, then drive additional ground rods into the ground 1 foot due east of the east leg of the tower, 1 foot due southwest leg of the tower, and 1 foot due west of the west side of the tower, in that order, to achieve a cumulative length of 8 feet of rod below ground level. Drive as few ground rods as necessary to achieve the cumulative length, but no more than four rods. After driving the rods, cut off any excess so that no more than 3 inches of rod protrude above ground level. In some locations where bedrock is very shallow (i.e., where it is impossible to achieve a cumulative length near 8 feet of ground rod below ground with four rods), use a grounding plate or mesh, rather than rods.

12. Bolt the tower to the two west base legs and lay the tower horizontally. Raise the top of the tower a few feet from the ground and support it in place to allow the attachment of equipment and hardware.

13. Bolt the static dissipator to the top of the northwest leg of the tower. Use a copper acorn clamp to attach a 6 AWG grounding wire to the base of the lightning rod just above the top of the tower leg. Route the grounding wire from the static dissipator down the northwest leg of the tower and secure it to the tower with non-conducting clamps. Ensure that the bend radius of each bend in the wire is 12 inches or greater.

14. Attach the guy wire cables to the tower by looping the cables around each of the three tower legs just above the top rung of the tower section (see Figure 5 below). Keep about 12 inches of excess cable on the tail/loose/dead end of the loop. After looping each cable around the tower leg, close the loop by attaching the shorter end of the loop to the longer end using two cable clamps, the first placed 4 inches from the tower leg and the second placed 2 inches from the end of the dead end of the cable. The saddle portion of each cable clamp should be against the load-bearing end of the cable. Tighten the clamps to 15 ft-lbs.

Figure 5. Photo showing guy wire attachment to the tower.

15. Attach the communication antenna at the top of the tower, oriented in the proper direction, route the antenna cable down the tower to the logger enclosure, and coil and secure any excess cable to the tower near the bottom of the logger enclosure. 2-4 feet of excess cable is OK; more than 4 feet is not acceptable.
16. Raise the tower and install all bolts to secure it in the upright position.
17. Attach the guy wire turnbuckles to each of the guy wire anchors, unscrewing the turnbuckles so that they are extended as far as possible. Attach the guy wire cables to the turnbuckles, looping each cable through its turnbuckle eye. Wrap the loop around a thimble to protect the guy wire cable from being kinked by the turnbuckle eye. Attach the dead end of the loop to the load-bearing end using two cable clamps, the first placed as close to the thimble as possible and the second placed 2 inches from the end of the dead end of the cable. The saddle portion of each cable clamp should be against the load-bearing end of the cable. Tighten the clamps to 15 ft-lbs. Figure 6 below shows how the final product should look after the turnbuckle eyes have been screwed back into their turnbuckles and the safety cables have been attached).

Figure 6. Photo showing guy wire attachment to the turnbuckle.

18. Tighten the turnbuckles so that the tower is plumb, as checked with a level, and the guy wires are neither loose nor completely taut. There should be some slack to allow the guy wires to contract in extreme winter temperatures without pulling the tower into the ground.
19. Thread a safety cable through the center of each turnbuckle, through the turnbuckle eye at the guy wire end, and through the eye in the guy anchor. Pull the cable ends together, taking up enough slack to prevent the turnbuckle from rotating more than one turn, and clamp them together with a cable clamp.
20. Attach the logger enclosure to the northeast side of the tower, placing the top of the enclosure no higher than 3 feet 5 inches above the bottom of the tower.

Note: It may be easier to mount the brackets for the logger enclosure, solar panel, and battery enclosure before mounting any of the equipment to provide adequate clearance for tightening the mounting bracket screws. In addition, spacers may be required to place the equipment far enough from the tower so that it does not interfere with equipment mounted to adjacent sides of the tower.

21. If a solar-powered site, attach the solar panel to its mount, oriented due south. Use below to set the tilt angle relative to horizontal (aimed directly upward) based on the site latitude.

Table 1. Solar panel tilt angle (from *Design Aids for Small PV Power Systems*, Solarex Corp.).

Site Latitude (degrees)	**Tilt Angle (degrees from horizontal)**
0 - 10	10
11 - 20	Latitude + 5
21 - 45	Latitude + 10
46 - 65	Latitude + 15
> 65	80

22. If a separate battery enclosure is supplied for a solar-powered site, attach it to the north side of the solar panel mounting pole.

23. Install conduit between the tower and the solar panel or solar battery enclosure, as shown in Figure 3. At the solar panel end, leave enough conduit length to attach it directly to the battery enclosurewith a conduit fitting or to route it to the solar panel junction box where the output cable is connected to prevent string trimmer, lawn mower, or animal damage to the cables. At the tower end, leave enough conduit length to attach it directly to the logger enclosure with a conduit fitting. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.

24. If a separate battery enclosure is supplied for an AC MAINS-powered site, attach it to the southeast side of the tower, placing the top of the enclosure at the same height as the top of the logger enclosure.

25. Install all equipment in the logger and battery enclosures, including: the data logger; VHF radio, cellular modem, or GOES transmitter; logger serial interface to logger (for VHF radio or cellular modem); multiplexer (if a site with soil moisture/temperature sensors); sensor signal conditioners; precipitation gauge heater, radio, and aspirator fan shutoff relays; voltage regulator or battery charger; batteries; battery terminal strip; fuse block and fuses; 120 VAC GFI outlet (if AC-powered); surge suppressor (if AC-powered); door switch; and barometer, if supplied. Refer to the wiring table and/or schematic provided with the data logger program to be used for proper wire connections and wire colors.

26. Attach the aspirated radiation shield for the air temperature and relative humidity sensor(s) to the end of its mounting arm, as shown in Figures 1 and 2. Mount the arm to the west-facing flat edge of the tower, with the shield's air inlet 4 feet 11 inches (1.5 meters) above the level of the ground directly below. Install the air temperature sensors and the relative humidity sensor, if provided, and connect them to the logger. Coil and secure any excess cable to the tower near the logger enclosure.

27. Attach the wetness sensor and GPS antenna, if a GOES transmitter will be installed, to the aspirated radiation shield mounting arm and connect them to the logger and GOES transmitter, respectively. Coil and secure any excess cable to the tower near the logger enclosure.
28. If provided, attach the pyranometer mounting plate to the pyranometer mounting arm. Attach the arm, oriented due south, to the tower so that the pyranometer will be 5 feet above the level of the ground directly below. Install the pyranometer and connect it to the logger. Coil and secure any excess cable to the tower near the logger enclosure.
29. Connect 6 AWG solid copper ground wires from the logger enclosure and from the tower (and from the solar panel mast, if applicable) to the north ground rod. Connect the north ground rod directly to each additional ground rod, if any, with 6 AWG solid copper ground wire, routing all wires at ground level to minimize tripping hazards. Use either copper or stainless steel acorn clamps for all connections, and ensure that all bend radii are 12 inches or larger.
30. Connect the grounding wire from the static dissipator to the ground rod with a copper or stainless steel acorn clamp.
31. If the station will be AC MAINS-powered, route the power line to the base of the tower and connect it to the outlet in the logger or battery enclosure (verify that the line circuit breaker is off and the line is not energized), if not already done. If visible, take a photo or photos showing where all underground AC lines are located in the plot, as explained in Section 12, Photographic Documentation of Station Installation section on Page 43. Sketch their locations in the as-built drawing.
32. Connect the battery(ies) to the regulator(s) (to the battery charger, if AC-powered) and to the station equipment and verify that the station is powered up. Inline fuses should be installed between the battery and the station and between the battery and the precipitation gauge heater, as specified in Table 2 below. If AC powered, a surge suppressor and a circuit breaker (if the battery charger does not have a built-in circuit breaker) should be installed between the AC line and the battery charger. Then connect the solar panel to the regulator (if AC-powered connect the AC power to the battery charger and turn it on) and verify that the battery is being charged.

Table 2. Current ratings of fuses to be installed between the battery and station equipment. The fuses should be ATO fast-acting automotive blade fuses.

Equipment	Fuse Rating (amps)
Logger/CDMA modem	3
GOES transmitter	7.5
GEONOR rim heater	7.5

33. Connect a computer to the data logger. Upload and run the appropriate program for the station, if it is not already stored in the logger, following the procedure included in the appendix of this manual.
34. Configure the LETS radio, cellular modem, or GOES transmitter. Verify that the standing wave ratio of the antenna system is within the acceptable limit, if a LETS radio or GOES transmitter, following the Radio-Antenna System SWR Test procedure on Page 33.

35. Install conduit between the tower and the precipitation gauge pedestal, as shown in Figure 3, allowing enough length to route it up the precipitation gauge pedestal to the base of the gauge and to the tower leg holding the data logger. At the tower end, leave enough conduit length to attach it directly to the logger enclosure with a conduit fitting to prevent string trimmer, lawn mower, or animal damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.
36. Install the precipitation gauge, following the procedure in Section 7, GEONOR Precipitation Gauge Installation, on Page 34.
37. Complete a calibration verification of the precipitation gauge to verify that the calibration is correct and that coefficients have been entered correctly, as described in Section 9, GEONOR Precipitation Gauge Calibration Verification, on Page 38.
38. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON Operations and Monitoring System has been established, and that data are being collected.
39. Repair the ground over all trenches, so that the surface is smooth and is not a tripping hazard.
40. Install a fence around the perimeter of the plot, if it has been decided that it is necessary at the site. Allow for technicians and observers to easily open and latch the fence or install a gate on the west side, due west of the tower.
41. Place 16 units (16 oz.) of desiccant in the logger enclosure.
42. If the logger enclosure is not fitted with cable glands, use sealing clay to seal all cable entry points.
43. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON Operations and Monitoring System has been established, and that data are being collected.
44. Complete all post-installation photos, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43.
45. Download the logger's current variable data, including all entered static parameters, to the PC.
46. Complete the installation checklist.
47. Complete the station metadata form.
48. Complete the mass install form.
49. Complete the as-built drawing, indicating variations from the standard NERON configuration.
50. Complete the obstruction drawing.
51. Complete the installation issues document.
52. Complete the site visit data verification.
53. Complete the site acceptance checklist.
54. Complete the NEPA statement.

55. Submit the completed precipitation gauge calibration sheet, photos named as specified in the photographic documentation section, the completed as-built drawing, the completed obstruction drawing, the completed mass install form, the completed station metadata form, and the completed installation checklist to the NERON Project Office at the National Weather Service.

3 Procedure for a Site with a 3-Meter Tower on a 32-by-32-Foot Plot

A site chosen for the installation of a 3-meter tower on a 32–by-32-foot plot has been determined to have adequate exposure for the installation of soil moisture/temperature sensors or an operational wind sensor and may later be expanded to a site with a tall tower.

Refer to Figures 7 thru 9 below for the positions and configuration of the equipment. In addition, these procedures cover installation for all possible sensors that could be installed at this type of site; not all of these sensors will be installed at every site.

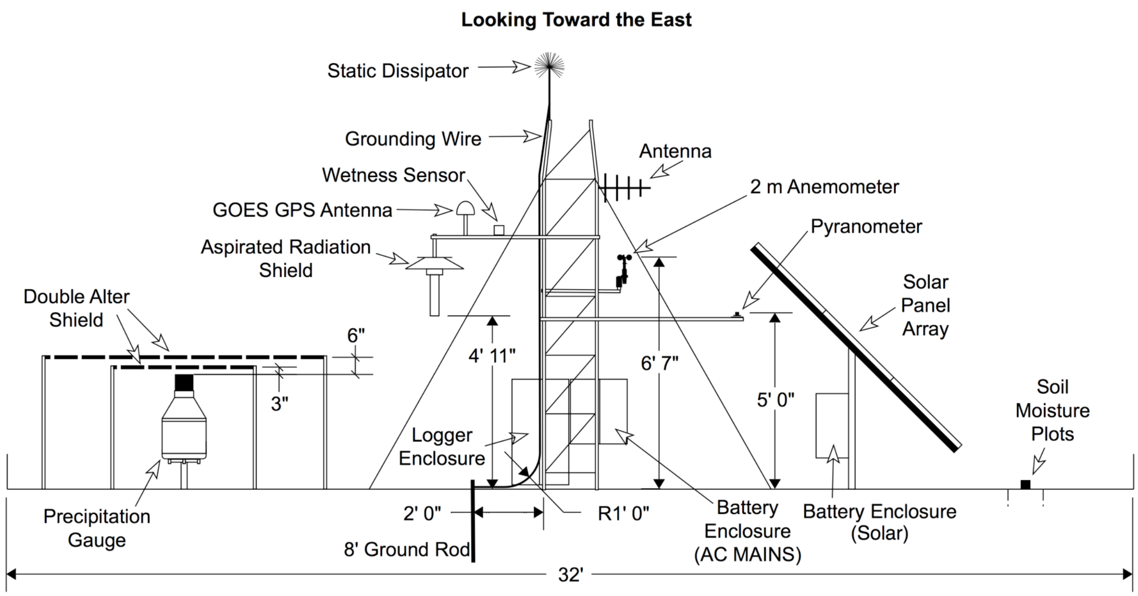

Figure 7. Profile view of a station plot that measures 32-by-32 feet and has a 3-meter tower.

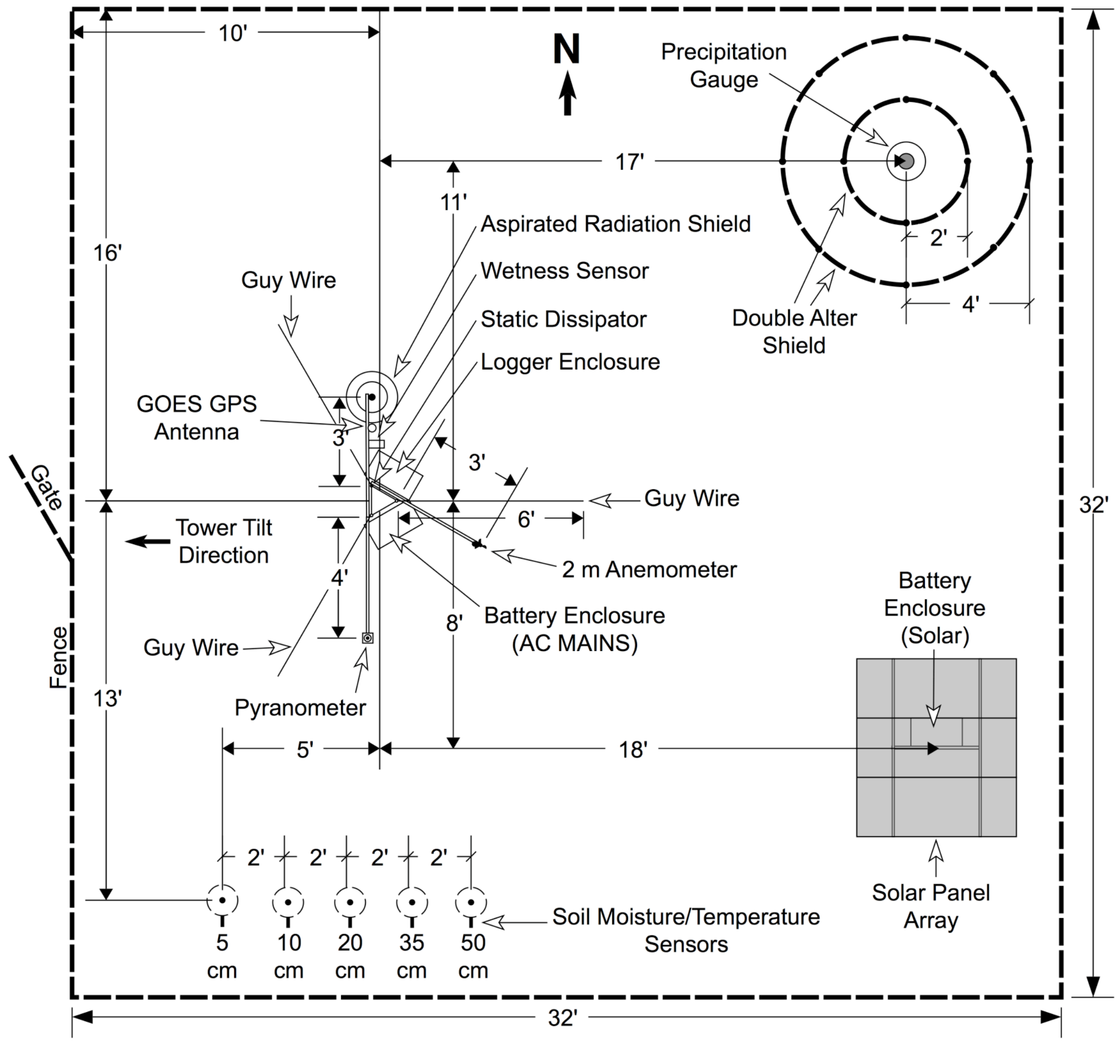

Figure 8. Plan view of a station plot that measures 32-by-32 feet and has a 3-meter tower.

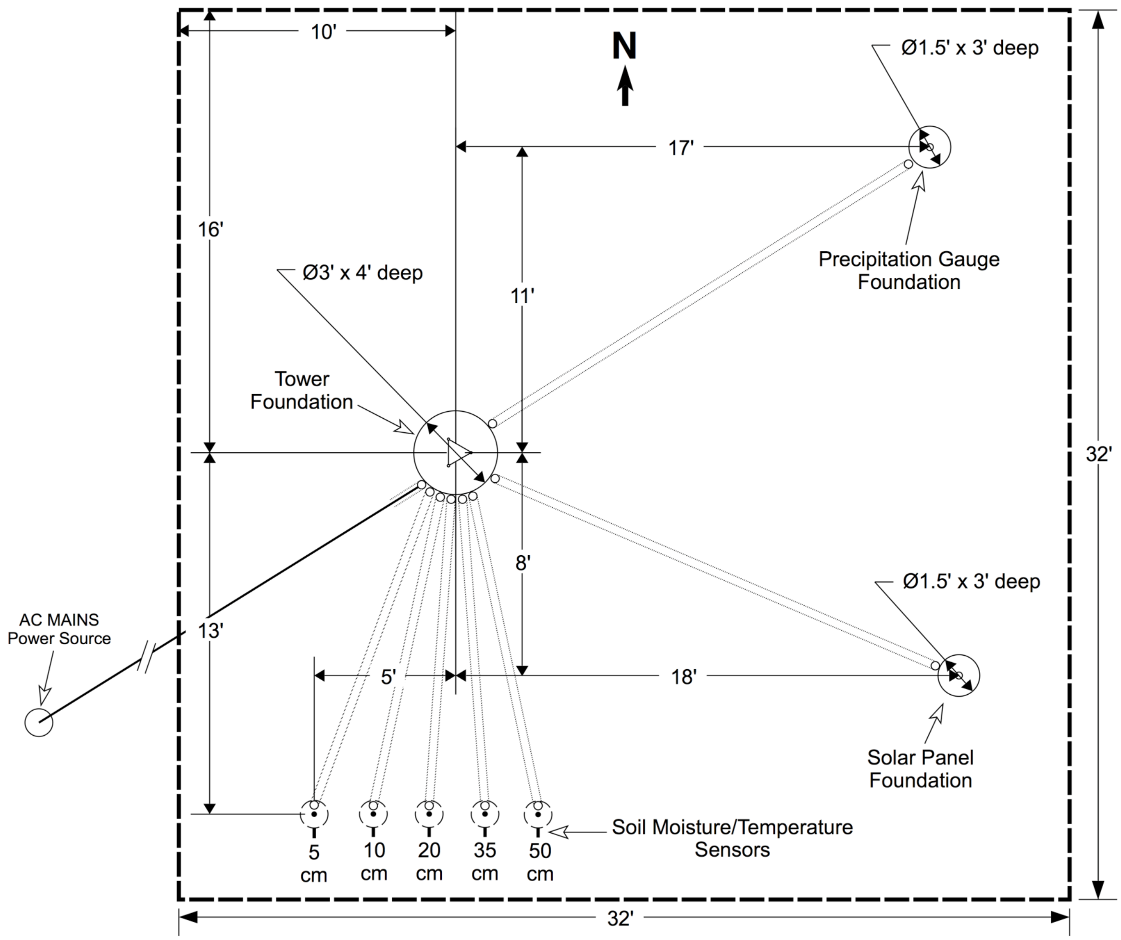

Figure 9. Plan view of a station plot that measures 32-by-32 feet showing the placement of foundations and conduit.

Note: All compass directions referred to in these procedures are referenced to true north.

1. Obtain verification that the site is clear of underground utility lines or, if any are present, that their locations are marked, and they can be avoided before digging.
2. Obtain information on the depth of the frost line if concrete foundations will be installed.
3. Complete all pre-installation photos, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. In addition, as installation progresses, document deviations from the standard configuration and any other notable findings, as described in the photographic documentation section.
4. Measure and mark the extent of the plot, assuming the stake placed by the surveyor represents the exact center of the plot.
5. If necessary, cut the vegetation in the plot as low as possible to make installation easier; plan for its maintenance at this level.

6. Install the tower base foundation, as shown in Figure 9, with the center of the tower 10 feet east and 16 feet south of the northwest corner of the plot. Install the tower base so that the tower will tilt to the west, with one of the flat tower sides facing due west (i.e., the side extends north-south). If a concrete foundation is necessary, take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Install the concrete base for the tower as illustrated in Figure 9.

7. Install the concrete foundation for the precipitation gauge 11 feet north and 17 feet east of the tower, as shown in Figure 9. The precipitation gauge must be centered at the location shown in Figure 9. Dig a hole 1.5 feet in diameter and 3 feet deep, and insert a cylindrical concrete form into the hole. Drive a 2" pipe that is long enough to extend from the bottom of the hole to the precipitation gauge mount into the ground at the center of the hole. Verify that the pipe is exactly vertical and centered in the concrete form, and secure it in place at the top of the hole with a jig. Take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Fill the concrete form with concrete and allow it to cure.

8. Install the solar panel mast foundation (if a solar panel is to be used) at a distance 8 feet south and 18 feet east of the tower, as shown in Figure 9. Dig a hole 1.5 feet in diameter and 3 feet deep, and insert a cylindrical concrete form into the hole. Drive a pipe of the proper size for the solar panel mount and that is long enough to extend from the bottom of the hole to the solar panel array mount into the ground at the center of the hole. Verify that the pipe is exactly vertical and centered in the concrete form, and secure it in place at the top of the hole with a jig. Take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Fill the concrete form with concrete and allow it to cure.

9. If the tower will not be free-standing (i.e., either no concrete foundation or a concrete foundation that is shallower than 2 feet deep or not resting on bedrock), select guy wire anchors appropriate to the soil type at the site, as specified in Table 3 on Page 32 in Section 5.

10. Mark the positions of the guy wire anchors, using a jig that fits on the three tower-base leg mounts (see below). The jig should have a string attached to the center of the jig that extends 6 feet past the tower leg. Pull the string taut and position it so that it passes directly over the center of the tower leg to which each guy wire will be attached to mark each of the three anchor positions. Install the guy wire anchors into the ground at the marked positions.

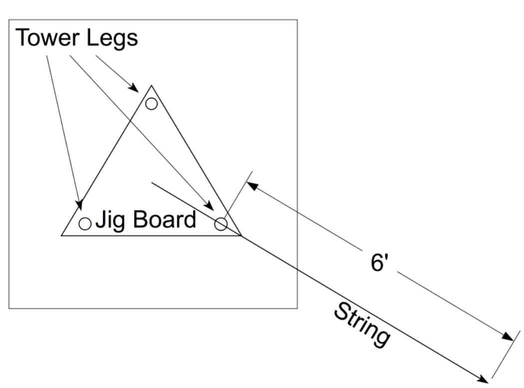

Figure 10. Diagram of a jig used to mark guy wire anchor positions for a 3-meter tower.

11. Drive the 8-foot, copper-clad steel ground rod into the ground 2 feet due north of the northwest leg of the tower. Leave 3 inches of rod above ground level to allow attachment of ground wires.

    Note: If it is not possible to drive the 8-foot ground rod fully into the ground in rocky soil or where the bedrock is shallow, then drive additional ground rods into the ground 1 foot due east of the east leg of the tower, 1 foot due southwest leg of the tower, and 1 foot due west of the west side of the tower, in that order, to achieve a cumulative length of 8 feet of rod below ground level. Drive as few ground rods as necessary to achieve the cumulative length, but no more than four rods. After driving the rods, cut off any excess so that no more than 3 inches of rod protrude above ground level. In some locations where bedrock is very shallow (i.e., where it is impossible to achieve a cumulative length near 8 feet of ground rod below ground with four rods), use a grounding plate or mesh, rather than rods.

12. Bolt the tower to the two west base legs and lay the tower horizontally. Raise the top of the tower a few feet from the ground and support it in place to allow the attachment of equipment and hardware.

13. Bolt the static dissipator to the top of the northwest leg of the tower. Use a copper acorn clamp to attach a 6 AWG grounding wire to the base of the lightning rod just above the top of the tower leg. Route the grounding wire from the static dissipator down the northwest leg of the tower and secure it to the tower with non-conducting clamps. Ensure that the bend radius of each bend in the wire is 12 inches or greater.

14. Attach the guy wire cables to the tower by looping the cables around each of the three tower legs just above the top rung of the tower section (see Figure 11 below). Keep about 12 inches of excess cable on the tail/loose/dead end of the loop. After looping each cable around the tower leg, close the loop by attaching the shorter end of the loop to the longer end using two cable clamps, the first placed 4 inches from the tower leg and the second placed 2 inches from the end of the dead end of the cable. The saddle portion of each cable clamp should be against the load-bearing end of the cable. Tighten the clamps to 15 ft-lbs.

Figure 11. Photo showing guy wire attachment to the tower

15. Attach the communication antenna at the top of the tower, oriented in the proper direction, route the antenna cable down the tower to the logger enclosure, and coil and secure any excess cable to the tower near the bottom of the logger enclosure. 2-4 feet of excess cable is OK; more than 4 feet is not acceptable.
16. Raise the tower and install all bolts to secure it in the upright position.
17. Attach the guy wire turnbuckles to each of the guy wire anchors, unscrewing the turnbuckles so that they are extended as far as possible. Attach the guy wire cables to the turnbuckles, looping each cable through its turnbuckle eye. Wrap the loop around a thimble to protect the guy wire cable from being kinked by the turnbuckle eye. Attach the dead end of the loop to the load-bearing end using two cable clamps, the first placed as close to the thimble as possible and the second placed 2 inches from the end of the dead end of the cable. The saddle portion of each cable clamp should be against the load-bearing end of the cable. Tighten the clamps to 15 ft-lbs. Figure 12 below shows how the final product should look after the turnbuckle eyes have been screwed back into their turnbuckles and the safety cables have been attached).

Figure 12. Photo showing guy wire attachment to the turnbuckle.

18. Tighten the turnbuckles so that the tower is plumb, as checked with a level, and the guy wires are neither loose nor completely taut. There should be some slack to allow the guy wires to contract in extreme winter temperatures without pulling the tower into the ground.
19. Thread a safety cable through the center of each turnbuckle, through the turnbuckle eye at the guy wire end, and through the eye in the guy anchor. Pull the cable ends together, taking up enough slack to prevent the turnbuckle from rotating more than one turn, and clamp them together with a cable clamp.
20. Attach the logger enclosure to the northeast side of the tower, placing the top of the enclosure no higher than 3 feet 5 inches above the bottom of the tower.

Note: It may be easier to mount the brackets for the logger enclosure, solar panel, and battery enclosure before mounting any of the equipment to provide adequate clearance for tightening the mounting bracket screws. In addition, spacers may be required to place the equipment far enough from the tower so that it does not interfere with equipment mounted to adjacent sides of the tower.

21. If a solar-powered site, attach the solar panel to its mount, oriented due south. Use on Page 9 to set the tilt angle relative to horizontal (aimed directly upward) based on the site latitude.

22. If a separate battery enclosure is supplied for a solar-powered site, attach it to the north side of the solar panel mounting pole.

23. Install conduit between the tower and the solar panel or solar battery enclosure, as shown in Figure 9. At the solar panel end, leave enough conduit length to attach it directly to the battery enclosurewith a conduit fitting or to route it to the solar panel junction box where the output cable is connected to prevent string trimmer, lawn mower, or animal damage to the cables. At the tower end, leave enough conduit length to attach it directly to the logger enclosure with a conduit fitting. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.

24. If a separate battery enclosure is supplied for an AC MAINS-powered site, attach it to the southeast side of the tower, placing the top of the enclosure at the same height as the top of the logger enclosure.

25. Install all equipment in the logger and battery enclosures, including: the data logger; VHF radio, cellular modem, or GOES transmitter; logger serial interface to logger (for VHF radio or cellular modem); multiplexer (if a site with soil moisture/temperature sensors); sensor signal conditioners; precipitation gauge heater, radio, and aspirator fan shutoff relays; voltage regulator or battery charger; batteries; battery terminal strip; fuse block and fuses; 120 VAC GFI outlet (if AC-powered); surge suppressor (if AC-powered); door switch; and barometer, if supplied. Refer to the wiring table and/or schematic provided with the data logger program to be used for proper wire connections and wire colors.

26. Attach the aspirated radiation shield for the air temperature and relative humidity sensor(s) to the end of its mounting arm, as shown in Figures 7 and 8. Mount the arm to the west-facing flat edge of the tower, with the shield's air inlet 4 feet 11 inches (1.5 meters) above the level of the ground directly below. Install the air temperature sensors and the relative humidity sensor, if provided, and connect them to the logger. Coil and secure any excess cable to the tower near the logger enclosure.

27. Attach the wetness sensor and GPS antenna, if a GOES transmitter will be installed, to the aspirated radiation shield mounting arm and connect them to the logger and GOES transmitter, respectively. Coil and secure any excess cable to the tower near the logger enclosure.

28. If provided, attach the pyranometer mounting plate to the pyranometer mounting arm. Attach the arm, oriented due south, to the tower so that the pyranometer will be 5 feet above the level of the ground directly below. Install the pyranometer and connect it to the logger. Coil and secure any excess cable to the tower near the logger enclosure.

29. If provided, mount the cup anemometer to the 2-meter wind arm and attach the arm to the north-east side of the tower, oriented to the southeast such that the cups are centered at 6 feet, 7 inches (2 meters) above ground level and 3 feet horizontally from the tower. Connect the anemometer to the logger. Coil and secure any excess cable to the tower near the logger enclosure.
30. Install the soil moisture/temperature probes, as described in Section 11, Soil Moisture/Temperature Sensor Installation, on Page 41. Because the soil moisture/temperature probes will be connected to a multiplexer, ensure that one is installed in the logger enclosure.
31. Connect 6 AWG solid copper ground wires from the logger enclosure and from the tower (and from the solar panel mast, if applicable) to the north ground rod. Connect the north ground rod directly to each additional ground rod, if any, with 6 AWG solid copper ground wire, routing all wires at ground level to minimize tripping hazards. Use either copper or stainless steel acorn clamps for all connections, and ensure that all bend radii are 12 inches or larger.
32. Connect the grounding wire from the static dissipator to the ground rod with a copper or stainless steel acorn clamp.
33. If the station will be AC MAINS-powered, route the power line to the base of the tower and connect it to the outlet in the logger or battery enclosure (verify that the line circuit breaker is off and the line is not energized), if not already done. If visible, take a photo or photos showing where all underground AC lines are located in the plot, as explained in Section 12, Photographic Documentation of Station Installation section on Page 43. Sketch their locations in the as-built drawing.
34. Connect the battery(ies) to the regulator(s) (to the battery charger, if AC-powered) and to the station equipment and verify that the station is powered up. Inline fuses should be installed between the battery and the station and between the battery and the precipitation gauge heater, as specified in Table 2 on Page 9. If AC powered, a surge suppressor and a circuit breaker (if the battery charger does not have a built-in circuit breaker) should be installed between the AC line and the battery charger. Then connect the solar panel to the regulator (if AC-powered connect the AC power to the battery charger and turn it on) and verify that the battery is being charged.
35. Connect a computer to the data logger. Upload and run the appropriate program for the station, if it is not already stored in the logger, following the procedure included in the appendix of this manual.
36. Configure the LETS radio, cellular modem, or GOES transmitter. Verify that the standing wave ratio of the antenna system is within the acceptable limit, if a LETS radio or GOES transmitter, following the Radio-Antenna System SWR Test procedure on Page 33.
37. Install conduit between the tower and the precipitation gauge pedestal, as shown in Figure 9, allowing enough length to route it up the precipitation gauge pedestal to the base of the gauge and to the tower leg holding the data logger. At the tower end, leave enough conduit length to attach it directly to the logger enclosure with a conduit fitting to prevent string trimmer, lawn mower, or animal damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.
38. Install the precipitation gauge, following the procedure in Section 7, GEONOR Precipitation Gauge Installation, on Page 34.

39. Complete a calibration verification of the precipitation gauge to verify that the calibration is correct and that coefficients have been entered correctly, as described in Section 9, GEONOR Precipitation Gauge Calibration Verification, on Page 38.
40. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON Operations and Monitoring System has been established, and that data are being collected.
41. Repair the ground over all trenches, so that the surface is smooth and is not a tripping hazard.
42. Install a fence around the perimeter of the plot, if it has been decided that it is necessary at the site. Allow for technicians and observers to easily open and latch the fence or install a gate on the west side, due west of the tower. The gate should be wide enough and positioned to provide adequate clearance for the tower when it is lowered, should the tower ever be extended to a height of 10 meters.
43. Place 16 units (16 oz.) of desiccant in the logger enclosure.
44. If the logger enclosure is not fitted with cable glands, use sealing clay to seal all cable entry points.
45. Complete all post-installation photos, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43.
46. Download the logger's current variable data, including all entered static parameters, to the PC.
47. Complete the installation checklist.
48. Complete the station metadata form.
49. Complete the mass install form.
50. Complete the as-built drawing, indicating variations from the standard NERON configuration.
51. Complete the obstruction drawing.
52. Complete the installation issues document.
53. Complete the site visit data verification.
54. Complete the site acceptance checklist.
55. Complete the NEPA statement.
56. Submit the completed precipitation gauge calibration sheet, photos named as specified in the photographic documentation section, the completed as-built drawing, the completed obstruction drawing, the completed mass install form, the completed station metadata form, and the completed installation checklist to the NERON Project Office at the National Weather Service.

4 Procedure for a Site with a Tall (10-meter) Tower on a 32-by-32-Foot Plot

A site selected for the installation of a tall tower has been determined to be a site suitable for the measurement of wind speed and direction. A tall tower will be on a minimum 32-by-32-foot plot due to the increased distance needed for the longer guy wires.

Note: Refer to Figures 13 thru 15 below for the positions and configuration of the equipment. In addition, these procedures cover installation for all possible sensors that could be installed at a tall tower site; not all of these sensors will be installed at every site.

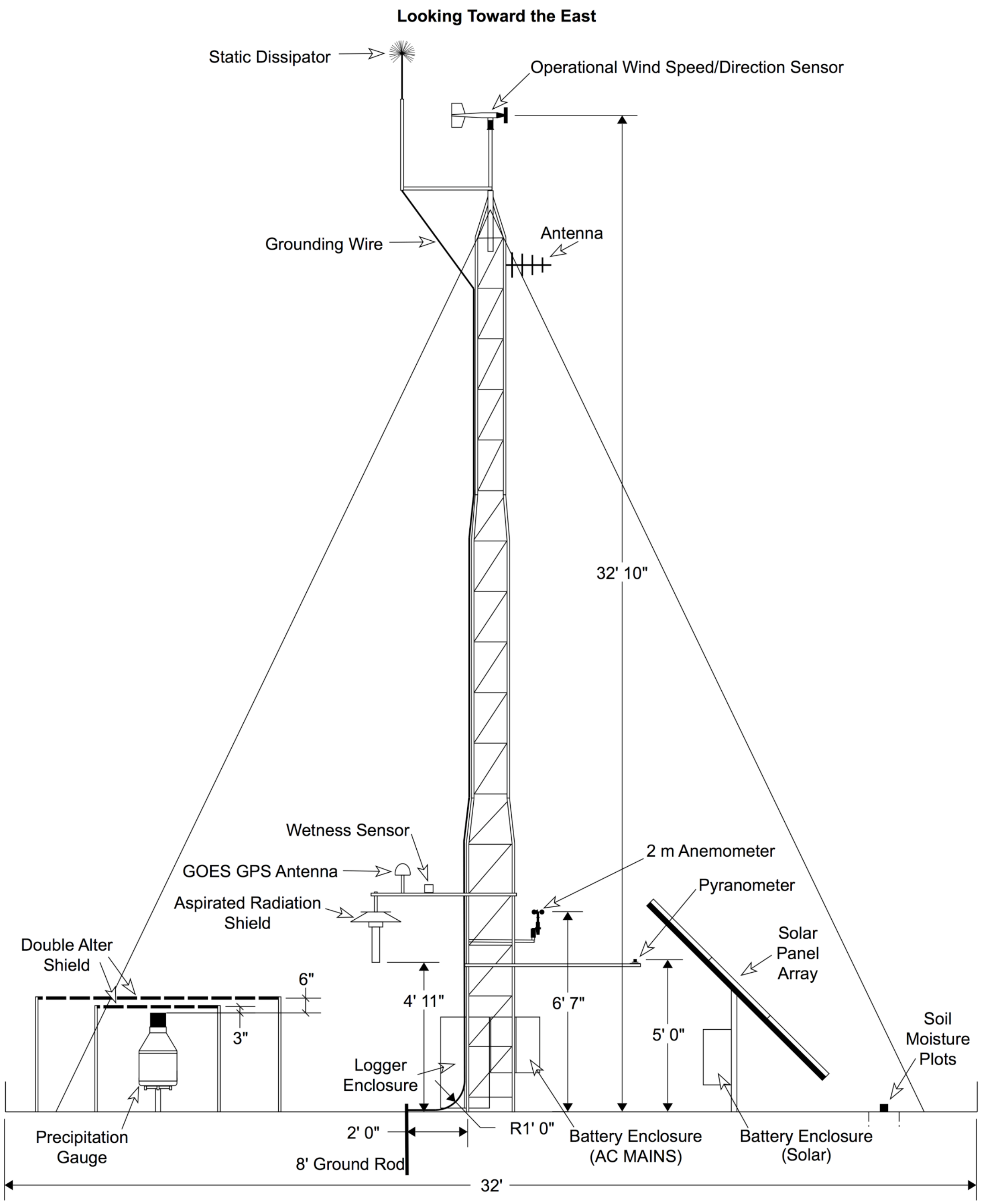

Figure 13. Profile view of a station plot that measures 32-by-32 feet and has a tall tower.

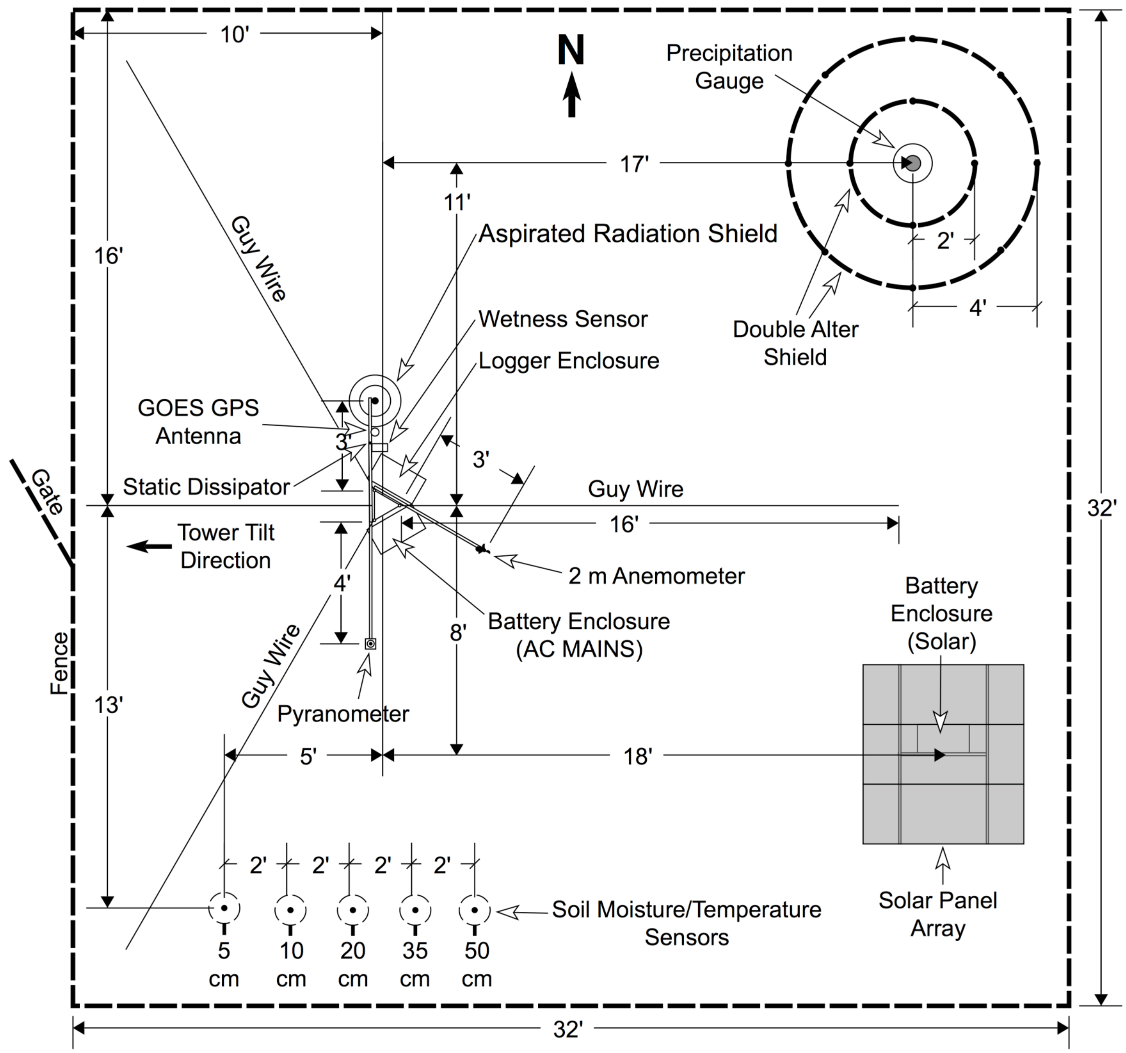

Figure 14. Plan view of a station plot that measures 32-by-32 feet and has a tall tower.

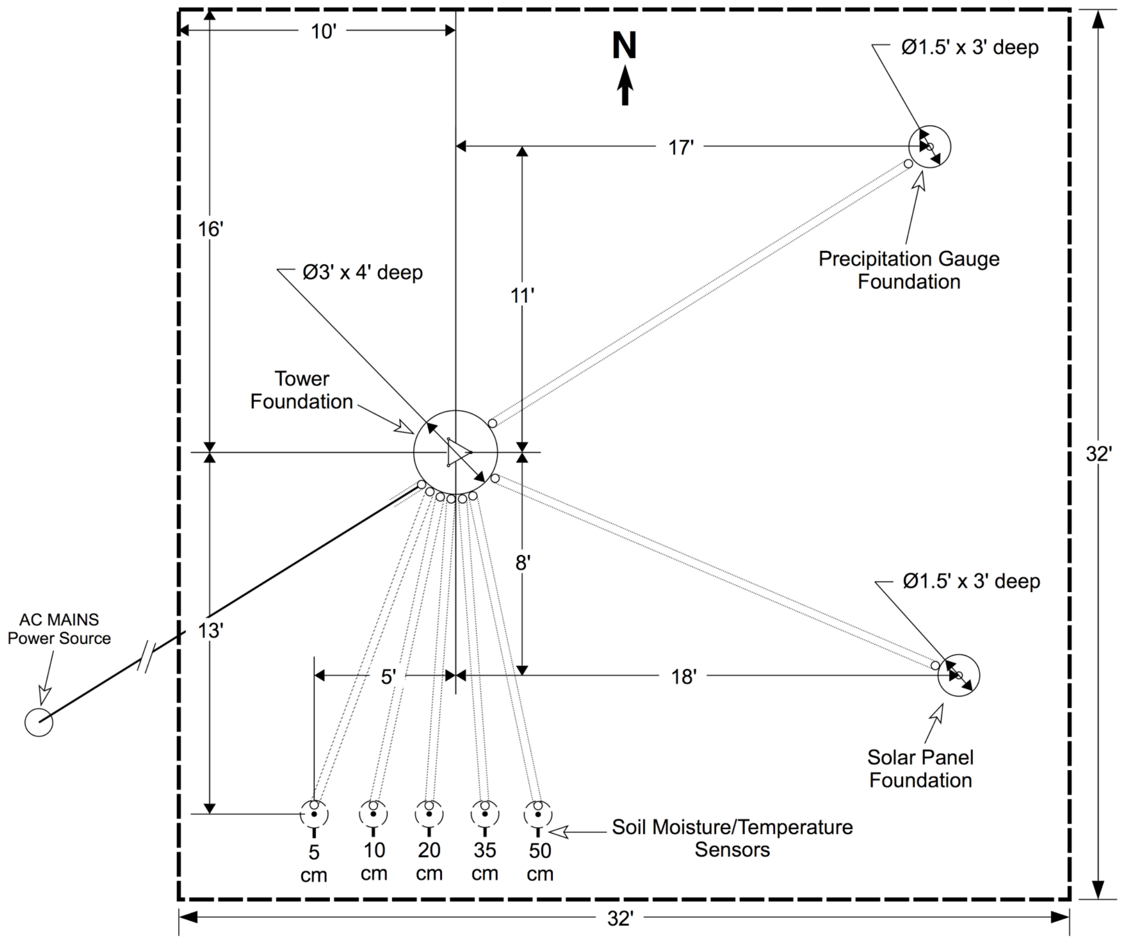

Figure 15. Plan view of a station plot that measures 32-by-32 feet showing the placement of foundations and conduit.

Note: All compass directions referred to in these procedures are referenced to true north.

1. Obtain verification that the site is clear of underground utility lines or, if any are present, that their locations are marked and they can be avoided before digging.
2. Obtain information on the depth of the frost line if concrete foundations will be installed.
3. Complete all pre-installation photos, as explained in the Photographic Documentation of Station Installation section beginning on Page 43. In addition, as installation progresses, document deviations from the standard configuration and any other notable findings, as described in the photographic documentation section.
4. Measure and mark the extent of the plot, assuming the stake placed by the surveyor represents the exact center of the plot.
5. If necessary, cut the vegetation in the plot as low as possible to make installation easier; plan for its maintenance at this level.

6. Install the tower base foundation, as shown in Figure 15, with the center of the tower 10 feet east and 16 feet south of the northwest corner of the plot. Install the tower base so that the tower will tilt to the west, with one of the flat tower sides facing due west (i.e., the side extends north-south). If a concrete foundation is necessary, take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Install the concrete base for the tower as illustrated in Figure 15.
7. Install the concrete foundation for the precipitation gauge 11 feet north and 17 feet east of the tower, as shown in Figure 15. The precipitation gauge must be centered at the location shown in Figure 15. Dig a hole 1.5 feet in diameter and 3 feet deep, and insert a cylindrical concrete form into the hole. Drive a 2" pipe that is long enough to extend from the bottom of the hole to the precipitation gauge mount into the ground at the center of the hole. Verify that the pipe is exactly vertical and centered in the concrete form, and secure it in place at the top of the hole with a jig. Take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Fill the concrete form with concrete and allow it to cure.
8. Install the solar panel mast foundation (if a solar panel is to be used) at a distance 8 feet south and 18 feet east of the tower, as shown in Figure 15. Dig a hole 1.5 feet in diameter and 3 feet deep, and insert a cylindrical concrete form into the hole. Drive a pipe of the proper size for the solar panel mount and that is long enough to extend from the bottom of the hole to the solar panel array mount into the ground at the center of the hole. Verify that the pipe is exactly vertical and centered in the concrete form, and secure it in place at the top of the hole with a jig. Take a photo of the foundation hole before pouring the concrete, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43. Fill the concrete form with concrete and allow it to cure.
9. If the tower will not be free-standing (i.e., either no concrete foundation or a concrete foundation that is shallower than 4 feet deep or not resting on bedrock), select guy wire anchors appropriate to the soil type at the site, as specified in Table 3 on Page 32 in Section 5.
10. Mark the positions of the guy wire anchors, using a jig that fits on the three tower-base leg mounts (see Figure 16 below). The jig should have a string attached to the center of the jig that extends 16 feet past the tower leg. Pull the string taut and position it so that it passes directly over the center of the tower leg to which each guy wire will be attached to mark each of the three anchor positions. Install the guy wire anchors into the ground at the marked positions.

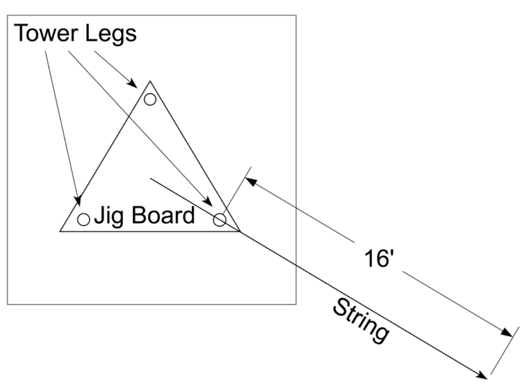

Figure 16. Diagram of a jig used to mark guy wire anchor positions for a 10-meter tower.

11. Drive the 8-foot, copper-clad steel ground rod into the ground 2 feet due north of the northwest leg of the tower. Leave 3 inches of rod above ground level to allow attachment of ground wires.

    Note: If it is not possible to drive the 8-foot ground rod fully into the ground in rocky soil or where the bedrock is shallow, then drive additional ground rods into the ground 1 foot due east of the east leg of the tower, 1 foot due southwest leg of the tower, and 1 foot due west of the west side of the tower, in that order, to achieve a cumulative length of 8 feet of rod below ground level. Drive as few ground rods as necessary to achieve the cumulative length, but no more than four rods. After driving the rods, cut off any excess so that no more than 3 inches of rod protrude above ground level. In some locations where bedrock is very shallow (i.e., where it is impossible to achieve a cumulative length near 8 feet of ground rod below ground with four rods), use a grounding plate or mesh, rather than rods.

12. Bolt all of the tower sections together horizontally on the ground and bolt them to the two west base legs. Raise the top of the tower a few feet from the ground and support it in place to allow the attachment of equipment and hardware.

13. Attach the logger enclosure to the northeast side of the tower, placing the top of the enclosure no higher than 3 feet 5 inches above the bottom of the tower.

    Note: It may be easier to mount the brackets for the logger enclosure, solar panel, and battery enclosure before mounting any of the equipment to provide adequate clearance for tightening the mounting bracket screws. In addition, spacers may be required to place the equipment far enough from the tower so that it does not interfere with equipment mounted to adjacent sides of the tower.

14. If a separate battery enclosure is supplied for an AC MAINS-powered site, attach it to the southeast side of the tower, placing the top of the enclosure at the same height as the top of the logger enclosure.

15. Attach the guy wire cables to the tower by looping the cables around each of the three tower legs just above the top rung of the tower section (see Figure 17 below). Keep about 12 inches of excess cable on the tail/loose/dead end of the loop. After looping each cable around the tower leg, close the loop by attaching the shorter end of the loop to the longer end using two cable clamps, the first placed 4 inches from the tower leg and the second placed 2 inches from the end of the dead end of the cable. The saddle portion of each cable clamp should be against the load-bearing end of the cable. Tighten the clamps to 15 ft-lbs.

Figure 17. Photo showing guy wire attachment to the tower.

16. Slide a pipe that fits inside and extends from the tapered top section of the tower. Slide a Holleander fitting for the static dissipator mouting arm down the pipe.
17. Install the operational wind prop vane on the pipe extending from the top of the tower. Extend the pipe from the top section to place the prop vane at 32 feet, 10 inches above ground level and secure it in place by tightening the bolts in the outer tube of the top section.
18. Slide the Holleander fitting for the static dissipator so that it rests against the top of the tapered section of the tower with the opening for the horizontal mounting pipe facing noth and tighten its set screws against the operational wind prop vane pipe. Slide the static dissipator horizontal mounting arm into the Holleander fitting and tighten the fitting's set screws. Bolt the static dissipator to the mounting arm. Use a copper acorn clamp to attach a 6 AWG grounding wire to the base of the lightning rod. Route the grounding wire from the static dissipator down the northwest leg of the tower and secure it to the tower with non-conducting clamps. Ensure that the bend radius of each bend in the wire is 12 inches or greater.

    Note: Mount the static dissipator high enough so that its tip is at least one foot higher than anything else mounted to the tower.
19. Attach the communication antenna at the top of the tower, oriented in the proper direction, route the antenna cable down the tower to the logger enclosure, and coil and secure any excess cable to the tower near the bottom of the logger enclosure. 2-4 feet of excess cable is OK; more than 4 feet is not acceptable.
20. If a solar-powered site, attach the solar panel to its mount, oriented due south. Use on Page 9 to set the tilt angle relative to horizontal (aimed directly upward) based on the site latitude.
21. If a separate battery enclosure is supplied for a solar-powered site, attach it to the north side of the solar panel mounting pole.

22. Install conduit between the tower and the solar panel or solar battery enclosure, as shown in Figure 15. At the solar panel end, leave enough conduit length to attach it directly to the battery enclosurewith a conduit fitting or to route it to the solar panel junction box where the output cable is connected to prevent string trimmer, lawn mower, or animal damage to the cables. At the tower end, leave enough conduit length to attach it directly to the logger enclosure with a conduit fitting. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.
23. Install all equipment in the logger and battery enclosures, including: the data logger; VHF radio, cellular modem, or GOES transmitter; logger serial interface to logger (for VHF radio or cellular modem); multiplexer (if a site with soil moisture/temperature sensors); sensor signal conditioners; precipitation gauge heater, radio, and aspirator fan shutoff relays; voltage regulator or battery charger; batteries; battery terminal strip; fuse block and fuses; 120 VAC GFI outlet (if AC-powered); surge suppressor (if AC-powered); door switch; and barometer, if supplied. Refer to the wiring table and/or schematic provided with the data logger program to be used for proper wire connections and wire colors.
24. Attach the aspirated radiation shield for the air temperature and relative humidity sensor(s) to the end of its mounting arm, as shown in Figures 13 and 14. Mount the arm to the west-facing flat edge of the tower, with the shield's air inlet 4 feet 11 inches (1.5 meters) above the level of the ground directly below. Install the air temperature sensors and the relative humidity sensor, if provided, and connect them to the logger. Coil and secure any excess cable to the tower near the logger enclosure.
25. Attach the wetness sensor and GPS antenna, if a GOES transmitter will be installed, to the aspirated radiation shield mounting arm and connect them to the logger and GOES transmitter, respectively. Coil and secure any excess cable to the tower near the logger enclosure.
26. If provided, attach the pyranometer mounting plate to the pyranometer mounting arm. Attach the arm, oriented due south, to the tower so that the pyranometer will be 5 feet above the level of the ground directly below. Install the pyranometer and connect it to the logger. Coil and secure any excess cable to the tower near the logger enclosure.
27. If provided, mount the cup anemometer to the 2-meter wind arm and attach the arm to the north-east side of the tower, oriented to the southeast such that the cups are centered at 6 feet, 7 inches (2 meters) above ground level and 3 feet horizontally from the tower. Connect the anemometer to the logger. Coil and secure any excess cable to the tower near the logger enclosure.
28. Install the soil moisture/temperature probes, as described in Section 11, Soil Moisture/Temperature Sensor Installation, on Page 41. Because the soil moisture/temperature probes will be connected to a multiplexer, ensure that one is installed in the logger enclosure.
29. Connect 6 AWG solid copper ground wires from the logger enclosure and from the tower (and from the solar panel mast, if applicable) to the north ground rod. Connect the north ground rod directly to each additional ground rod, if any, with 6 AWG solid copper ground wire, routing all wires at ground level to minimize tripping hazards. Use either copper or stainless steel acorn clamps for all connections, and ensure that all bend radii are 12 inches or larger.
30. Connect the grounding wire from the static dissipator to the ground rod with a copper or stainless steel acorn clamp.

31. If the station will be AC MAINS-powered, route the power line to the base of the tower and connect it to the outlet in the logger or battery enclosure (verify that the line circuit breaker is off and the line is not energized), if not already done. If visible, take a photo or photos showing where all underground AC lines are located in the plot, as explained in Section 12, Photographic Documentation of Station Installation section on Page 43. Sketch their locations in the as-built drawing.
32. Connect the battery(ies) to the regulator(s) (to the battery charger, if AC-powered) and to the station equipment and verify that the station is powered up. Inline fuses should be installed between the battery and the station and between the battery and the precipitation gauge heater, as specified in Table 2 on Page 9. If AC powered, a surge suppressor and a circuit breaker (if the battery charger does not have a built-in circuit breaker) should be installed between the AC line and the battery charger. Then connect the solar panel to the regulator (if AC-powered connect the AC power to the battery charger and turn it on) and verify that the battery is being charged.
33. Connect a computer to the data logger. Upload and run the appropriate program for the station, if it is not already stored in the logger, following the procedure included in the appendix of this manual.
34. Configure the LETS radio, cellular modem, or GOES transmitter. Verify that the standing wave ratio of the antenna system is within the acceptable limit, if a LETS radio or GOES transmitter, following the Radio-Antenna System SWR Test procedure on Page 33.
35. Install conduit between the tower and the precipitation gauge pedestal, as shown in Figure 15, allowing enough length to route it up the precipitation gauge pedestal to the base of the gauge. At the tower end, leave enough conduit length to attach it directly to the logger enclosure with a conduit fitting to prevent string trimmer, lawn mower, or animal damage to the cables. Bury the conduit so that it is at or below ground level to allow a mower to pass over it.
36. Install the precipitation gauge, following the procedure in Section 7, GEONOR Precipitation Gauge Installation, on Page 34.
37. Attach the guy wire turnbuckles to each of the guy wire anchors, unscrewing the turnbuckles so that they are extended as far as possible. Unscrew the upper eye completely from the east turnbuckle. Attach the guy wire cables to the turnbuckles, looping each cable through its turnbuckle eye. Wrap the loop around a thimble to protect the guy wire cable from being kinked by the turnbuckle eye. Attach the dead end of the loop to the load-bearing end using two cable clamps, the first placed as close to the thimble as possible and the second placed 2 inches from the end of the dead end of the cable. The saddle portion of each cable clamp should be against the load-bearing end of the cable. Tighten the clamps to 15 ft-lbs.
38. Raise the tower and install all bolts to secure it in the upright position.
39. Screw the east turnbuckle eye back into its turnbuckle. Tighten the turnbuckles so that the tower is plumb, as checked with a level, and the guy wires are neither loose nor completely taut. There should be some slack to allow the guy wires to contract in extreme winter temperatures without pulling the tower into the ground.
40. Refer to the procedure in Section 10, Operational Wind Vane Alignment, on Page 39 to orient the vane's directional sensor.

41. Verify that all sensor readings reported by the data logger are reasonable, that positive communication between the site and the NERON Operations and Monitoring System has been established, and that data are being collected.
42. Thread a safety cable through the center of each turnbuckle, through the turnbuckle eye at the guy wire end, and through the eye in the guy anchor. Pull the cable ends together, taking up enough slack to prevent the turnbuckle from rotating more than one turn, and clamp them together with a cable clamp. Figure 18 below shows how the final product should look after the turnbuckle eyes have been screwed back into their turnbuckles and the safety cables have been attached).

Figure 18. Photo showing guy wire attachment to the turnbuckle.

43. Complete a calibration verification of the precipitation gauge to verify that the calibration is correct and that coefficients have been entered correctly, as described in Section 9, GEONOR Precipitation Gauge Calibration Verification, on Page 38.
44. Repair the ground over all trenches, so that the surface is smooth and is not a tripping hazard.
45. Install a fence around the perimeter of the plot, if it has been decided that it is necessary at the site. Allow for technicians and observers to easily open and latch the fence or install a gate on the west side, due west of the tower. The gate should be wide enough and positioned to provide adequate clearance for the tower when it is lowered, should the tower ever be extended to a height of 10 meters.
46. Place 16 units (16 oz.) of desiccant in the logger enclosure.
47. If the logger enclosure is not fitted with cable glands, use sealing clay to seal all cable entry points.
48. Complete all post-installation photos, as explained in Section 12, Photographic Documentation of Station Installation, beginning on Page 43.
49. Download the logger’s current variable data, including all entered static parameters, to the PC.

50. Complete the installation checklist.
51. Complete the station metadata form.
52. Complete the mass install form.
53. Complete the as-built drawing, indicating variations from the standard NERON configuration.
54. Complete the obstruction drawing.
55. Complete the installation issues document.
56. Complete the site visit data verification.
57. Complete the site acceptance checklist.
58. Complete the NEPA statement.
59. Submit the completed precipitation gauge calibration sheet, photos named as specified in the photographic documentation section, the completed as-built drawing, the completed obstruction drawing, the completed mass install form, the completed station metadata form, and the completed installation checklist to the NERON Project Office at the National Weather Service.

5 Tower Guy Wire Anchors

To properly anchor the tower guy wires, consideration must be given to the type of material (soil, rock, etc.) into which the anchors will be driven. Table 3 below should be used as a guide in selecting the appropriate anchor type.

Table 3. Guy wire anchor types appropriate for each site soil type (from *80 Foot Land Tower Kit Installation Manual* by Southwest Windpower, Inc.).

Soil Type	Recommended Anchor	Alternative Anchor
Sand or Cinders	Screw Anchor in Concrete	None
Loose Gravel	Screw Anchor in Concrete	None
Loam	Screw Anchor or Duckbill	Screw Anchor in Concrete
Clay	Screw Anchor in Concrete	Screw Anchor in Concrete
Rocky Soil	Duckbill	Screw Anchor in Concrete
Gravely Soil	Screw Anchor or Duckbill	Screw Anchor in Concrete
Solid (Soft) Rock (Sandstone, limestone, etc)	Large Eye Bolt + Chemical Cement	None
Solid (Medium)Rock (dacite, welded tufts, dense varieties of sandstone, etc)	Large Expansion Bolt	Large Eye Bolt + Chemical Cement
Solid (Hard) Rock (granite, basalt, etc)	Small Expansion Bolt	None

Table 4. The minimum specifications for the above listed anchor types are as follows:

Anchor	Specification	Notes
Screw Anchor	5/8" diameter. x 4 ' long	2,500# holding capacity
Screw Anchor in Concrete	5/8" diameter x 4' long embedded in a 30" diameter x 12" deep concrete base	
Duckbill	1.75" wide x 6.25" long	2,500# holding capacity
Large Eye Bolt	5/8" diameter x 9" long	
Large Expansion Bolt	1/2" diameter x 7" long	
Small Expansion Bolt	3/8" diameter x 4" long	

6 Radio-Antenna System SWR Test

Use an RF power meter placed between the transmitter and the antenna cable at sites with GOES or LETS radios. Verify that the meter is rated or set for the frequency range of the transmitter. Table 5 below lists forward power (P_f) values and the corresponding reflected power (P_r) values for standing wave ratios (SWR) of 1.5:1, 2:1, and 3:1. For optimum communication quality, the SWR should be less than 1.5:1, though a value less than 2:1 is acceptable. If the SWR is 2:1 or greater but less than 3:1, a problem exists that should be fixed soon, though the radio can continue to operate. If the SWR is 3:1 or greater, then the radio can be damaged and should be immediately turned off, and left off until the problem is fixed.

Table 5. Forward power (P_f) and corresponding reflected power (P_r) values for standing wave ratios of 1.5:1, 2:1, and 3:1 for radio-antenna systems.

P_f (W)	P_r 1.5:1 SWR (W)	P_r 2:1 SWR (W)	P_r 3:1 SWR (W)
10.0	0.40	1.11	2.50
9.0	0.36	1.00	2.25
8.0	0.32	0.89	2.00
7.0	0.28	0.78	1.75
6.0	0.24	0.67	1.50
5.0	0.20	0.56	1.25
4.0	0.16	0.44	1.00
3.0	0.12	0.33	0.75
2.0	0.08	0.22	0.50
1.5	0.06	0.17	0.38
1.0	0.04	0.11	0.25
0.8	0.03	0.09	0.20
0.6	0.02	0.07	0.15
0.4	0.02	0.04	0.10
0.2	0.01	0.02	0.05

Check all of the coaxial cable connectors for security, damage, corrosion, or bent center pins; check the antenna for damage; and check the entire length of coaxial cable for wear, damage, or cuts. Any of these conditions could attenuate RF signal power at the antenna and/or reflect power toward the transmitter, which would increase the standing wave ratio and further reduce transmission power. Replace or repair damaged components. In addition, if the SWR is too high, check that there are no nearby metal objects above, below, or to either side of the antenna.

7 GEONOR Precipitation Gauge Installation

(Adapted from GEONOR Users Manual for Precipitation Gauge T-200)

1. Separate the housing from the precipitation gauge. Release the three toggle clamps on the sides of the gauge toward the bottom and lift the housing from the base.
2. Attach the base to the pedestal using three M8 bolts. Level the base using a bubble level by adjusting the three hexagonal adjusting screws under the base. Carefully tighten the M8 screws without disturbing the level of the gauge.
3. Slide the cable gland onto the precipitation gauge cable and feed the precipitation gauge cable through the threaded hole in the bottom of the gauge. Screw the cable gland into the hole and tighten the gland screw snugly against the cable. Connect the leads to the three vibrating wire transient arrestor boxes attached to the upper flange of the gauge base. It is important to connect the three positive vibrating wire cable leads to the transient arrestor boxes corresponding to the correct vibrating wire sensors so that the correct calibration coefficients will be applied. The south vibrating wire sensor is designated #1 (VWPCP1), the northwest sensor is #2 (VWPCP2), and the northeast sensor is #3 (VWPCP3). Connect the wires as indicated in the wiring table or schematic for the logger program to be used.

   Note: The *transient arrestor boxes* are positioned clockwise from the vibrating wire sensors they are attached to and their positions should not be confused with the positions of the wires. The numbering of the sensors is based solely on the locations of the sensors, not their transient arrestor boxes.
4. Place the aluminum bucket support dish in the bottom of the base.
5. Attach the three vibrating wire sensor assemblies to the upper flange of the gauge body. They are suspended by adjustment screws placed in square holes. Verify that the vibrating wire sensors slide freely in the square holes, and enlarge the holes with a file if they do not.
6. Secure the aluminum support dish to the vibrating wire sensors with the S-hooks hanging from the sensors.
7. Secure the cables attached to the tops of the sensor assemblies to the gauge base using plastic cable ties. Route the cables so that they do not come into contact with the suspended parts and ensure that the bend radii are sufficiently large to avoid undesirable mechanical stress being transmitted to the sensor assemblies.
8. Wire each sensor cable to its terminal box: red to Out + (Terminal 6) and blue to Out – (Terminal 4).
9. Verify that the aluminum support dish is hanging freely and secure any cables that come into contact with it.
10. Insert the bucket, aligning the dot on the bucket with the dot placed on the upper flange of the gauge next to one of the vibrating wire sensor suspension holes. This ensures correct calibration if the bucket is removed and replaced.
11. Place the level on the rim of the bucket and level it by adjusting the three black knurled nuts on the upper flange from which the vibrating wire sensors are suspended. Take cross readings with the level to ensure proper level in two dimensions. These readings ensure that the three assemblies carry identical loads, maximizing accuracy.

12. Verify that the bucket does not come into contact with the cable in the base of the gauge. Raise all three vibrating wire sensors with their adjusting nuts, if necessary.
13. To release each vibrating wire assembly from its transport position, remove the red tape and unscrew the black screw on the lower part of each vibrating wire sensor.
14. Connect the rim heater cable to the leads from the heater using a weatherproof connector at the level of the base of the gauge.
15. Feed the precipitation gauge and rim heater cables through the conduit.
16. Secure the conduit to the precipitation gauge pedestal and to the mast or tower at the other end. Coil and secure any excess cable to the mast/tower near the bottom of the logger enclosure. Do not store an excess of cable. Plug the conduit ends with sealant to prevent moisture and insects from entering the conduit.
17. Connect the cable to the data logger, verify that the three vibrating wires are vibrating audibly, and verify that the precipitation values reported by the logger are reasonable.
18. Connect the heater wires as indicated in the wiring table for the logger program to be used.
19. Calibrate the precipitation gauge, following the procedure in Section 8, GEONOR Precipitation Gauge Calibration, on Page 36.
20. Refer to the precipitation gauge antifreeze guid
21. Tighten the black transport screws at the bottom of each vibrating wire sensor to protect the wires from breaking as antifreeze is added to the bucket.
22. Add the necessary mixture of antifreeze and water for the station location, according to the guidelines in the Site Maintenance Plan.
23. Loosen and remove the transport set screw from each vibrating wire sensor and place it in the bottom of the base. Store the screws in the base of the gauge, resting them against the three bumps in the base toward the outside of the gauge so that if the bucket overflows, the screws will be less likely to be hidden under water at the center of the gauge base.
24. Replace the gauge housing and secure it with the toggle clamps.
25. Mark the positions on the ground for installation of the double Alter Shield support posts. If the ground is flat, lay the slat sections of the inner Alter shield ring on the ground in a 4-foot-diameter ring centered around the precipitation gauge and mark or drill pilot holes for the four posts. Repeat for the outer 8-foot-diameter ring; there will be eight posts.
26. Drill pilot holes for the posts into the ground with a hammer drill and a bit that is slightly smaller than the post diameter.
27. Hammer each post into the ground, checking frequently that it is vertical with a level.
28. Slide the slat section support pipes into the posts and tighten the set screws to put the tops of the inner ring of slats 3 inches above the top of the gauge orifice and the tops of the outer ring of slats 6 inches above the gauge orifice.
29. Slide the slat sections into the mounting tubes on the support pipes. Starting with the inner ring.

8 GEONOR Precipitation Gauge Calibration

(From NOAA/ATDD & NCDC Climate Reference Network Documentation Manual)

Equipment

- 11 Troemer-certified machined brass 1000g calibration weights and an aluminum base/centering weight
- Computer with MS Excel

Test Method

The GEONOR Rain Gauge has a fill capacity of 12 liters (12.72 quarts). At 4°C, one liter of water weighs 1000g. The machined weights weigh 1000.0g ±0.1g and represent one liter of water. The known weights are added to the gauge and the output is recorded. From these values, calibration curves are developed using Excel's linear regression feature.

Test Procedure

1. Record all precipitation gauge serial numbers on the GEONOR precipitation gauge calibration sheet.
2. After the rain gauge has been properly installed and leveled at the test site, record the initial output. Carefully add the aluminum base/centering weight to the bucket, wait two minutes, and record the frequencies of the individual sensors. Carefully add the first brass weight, wait two minutes and record the frequency. Repeat ten more times to reach the maximum gauge capacity.

   Note: The weights should be added slowly and carefully to avoid breaking any of the vibrating wires.
3. Enter the values into the GEONOR calibration sheet Excel file, shown in Figure 19, to perform a second-order linear regression analysis to determine the equation to relate frequency to rainfall depth (Depth (mm) vs. F-Fo).
4. Enter the coefficients into the data logger's static parameters.

Form Date: 20060210

NERON GEONOR CALIBRATION SHEET

STATION ID	DATE	TECHNICIAN NAME(S)		TECHNICIAN AFFILIATION
NONO2	2006-02-16	H WESTBROOK, B FLEIG		QSS
VIB WIRE POSITION	VIBRATING WIRE SN	PRECIP SN	BUCKET SN	
VWPCP2 (NW)	62004	50517002	50517002	

F_0	A	B
1037.7	1.7100E-02	9.3510E-06

WEIGHT (g)	DEPTH (cm)	FREQ. (F) (Hz)		F - Fo (Hz)
0	0	1037.7	(= Fo)	0.0
1000	5	1293.0		255.3
2000	10	1503.4		465.7
3000	15	1685.9		648.2
4000	20	1848.4		810.7
5000	25	1997.1		959.4
6000	30	2134.8		1097.1
7000	35	2263.2		1225.5
8000	40	2384.3		1346.6
9000	45	2498.7		1461
10000	50	2610.9		1573.2
11000	55	2715.3		1677.6
12000	60	2816.4		1778.7

EQUATION : DEPTH = A(F - F0) + B(F - F0)^2
A = x coef., B = x^2 coef. and (F - F0) = x

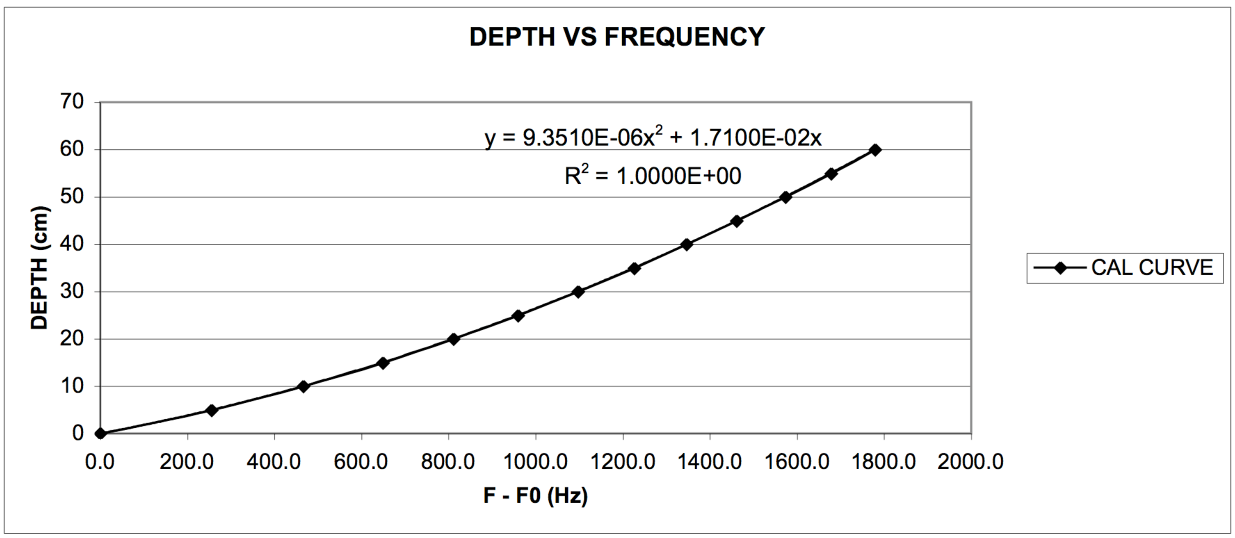

Figure 19. Sample input to and resulting calibration curve from the GEONOR calibration sheet Excel file.

9 GEONOR Precipitation Gauge Calibration Verification

1. Verify that the gauge frame and bucket are level.
2. Enter the serial numbers of the gauge base and each of the three vibrating wire sensors on the site visit data verification form.
3. Place either the aluminum base/centering calibration weight or 1000 ml of water, measured with a volumetric flask, in the bucket, wait two minutes, and record the precipitation values reported by the individual sensors, their average, and the percentage differences from the goal value of 50.0 mm on the site visit data verification form.
4. If the precipitation value reported by any individual sensor differs from 50.0 mm by more than 3%, then check the coefficients entered in the logger to confirm that they match those calculated on the calibration sheet. Recalibrate the gauge if the coefficients were entered correctly, as described in Section 8, GEONOR Precipitation Gauge Calibration, on Page 36.

10 Operational Wind Vane Alignment

1. Wire the wind vane and speed sensor to the logger, as indicated in the wiring table and/or schematic for the logger program to be used.
2. Once the wind vane has been attached to the top of the tower, secure the vane in place with a clamp, oriented so that when the tower is raised, the vane will point into the wind to minimize the possibility of the vane rotating or vibrating while measuring the vane azimuth, as shown in Figure 20 below.

   NOTE: Since a vane's potentiometer usually has a dead zone of up to 8 degrees, in which indicated azimuth indication may be constant, always clamp the vane so that its orientation is at least 10 degrees outside of the dead zone. The dead zone often covers azimuths between 352 and 360 degrees.

Figure 20. Wind vane clamp.

3. Set up a transit or a magnifying scope with an electronic compass at least 100 feet from the tower in the direction that the vane's tail will point once the tower is raised.
4. Remove all ferrous metal objects from your person and from as large a radius as possible around the transit or magnetic compass. Even very small metal objects within a few feet of a compass can cause errors of a few degrees. The tripod used to mount the transit or electronic compass must be completely non-ferrous. If there are metal objects, conduit, or pipeline buried in the

ground nearby, move the transit or electronic compass farther outward or rotate the vane so that the reading can be taken well away from their influence.

5. Raise the tower and adjust the guy wire tension so that the tower is plumb. Do not install the guy wire turnbuckle safety wires, since the tower will need to be lowered after measuring the vane azimuth to adjust the vane's potentiometer alignment.
6. Align the transit or electronic compass tripod position in the tangential direction as exactly as possible with the vane's body, as shown in Figure 21 below. The vane's tail should appear as a thin vertical line and neither of the tail's sides should be visible.

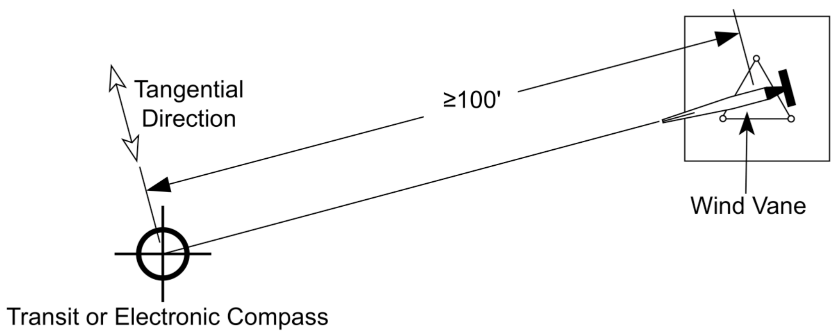

Figure 21. Transit or electronic compass placement.

7. Obtain the station's magnetic declination to an accuracy of at least 0.5 degrees and adjust the transit or magnetic compass to indicate azimuth relative to true north. If magnetic declination is east, then add the declination to the magnetic indication; if magnetic declination is west, then subtract the declination from the magnetic indication.
8. Align the transit or electronic compass crosshairs with the center of the mount at the base of the vane and write down the true azimuth measured.
9. Lower the tower. Ensure that the clamp holding the vane in place remains tight and that the vane does not rotate.
10. Use a keypad display or laptop computer connected to the data logger to display the current direction sensor output of the wind vane. Rotate the wind vane's potentiometer collar until the data logger's direction indication matches the true azimuth measured with the tripod or electronic compass as closely as possible. At a minimum, the indication should be within 0.5 degrees of the measured azimuth.
11. Tighten the wind vane's potentiometer collar, ensuring that the data logger's direction indication does not change in the process, and remove the vane clamp.

11 Soil Moisture/Temperature Sensor Installation

Note: The soil moisture/temperature probe should be handled carefully to avoid bending the tines or nicking or scratching the sensor head from which the tines protrude. Bending the tines will cause erroneous readings, since they must be at a set distance from each other to obtain accurate soil capacitance and inductance readings. Deep nicks or scratches in the sensor head could expose the electronics to moisture, permanently damaging the sensor.

1. Locate and mark the hole locations at the positions shown in Figures 7 or 13, and in Table 6 below.

Table 6. Soil moisture/temperature probe installation hole locations relative to the center of the mast or tower.

Sensor Depth (cm)	Position E-W (ft)	Position N-S (ft)
5 (2 in)	5 W	13 S
10 (4 in)	3 W	13 S
20 (8 in)	1 W	13 S
35 (14 in)	1 E	13 S
50 (20 in)	3 E	13 S

2. Remove and set aside a 10-inch diameter sod plug for each hole, being careful to keep the sod as intact as possible to recover the hole when installation is complete.
3. Excavate the hole to a depth 10 inches greater than the sensor depth. This will provide a collection area below the actual sensor for any water that seeps down the inner surface of the hole. Use a gas-powered auger (10-inch diameter) for 20- and 40-inch sensors. Post hole diggers may be used for 2-, 4-, and 8-inch sensors. Collect the excavated soil on a tarp, preserving the order of removal so that the soil stratification can be restored as much as possible when refilling the hole.
4. Take an approximately 4-cubic-inch soil sample at the sensor depth from the west, east, and/or north sides of the hole and place it in a plastic zipper-seal bag; label the station, depth, and date on the bag. Submit it to (TO BE DETERMINED) for analysis.
5. Install conduit extending from the tower to just below sensor depth at the north side of the installation hole. Extend the conduit at least one foot above ground level at the tower end to prevent string trimmer or lawnmower damage to the cables. For 2-inch, 4-inch, and 8-inch sensors, cut and install a length of wire braid material to extend from the sensor to a few inches inside the end of the conduit to discourage burrowing animals from chewing through the cable. Feed the sensor cable through the conduit and push the metal braid a few inches into the conduit. Bury the conduit so that its top is at or below ground level, to allow a mower to pass over it.
6. Use a putty knife or paint scraper to smooth out the vertical surface on the south side of the hole at the sensor depth and to make it as vertical as possible.

7. Use a measuring stick and a straight edge placed horizontally at ground level at the top of the hole to determine the exact depth at which to install the sensor.
8. Insert the sensor horizontally into the soil, pointing south, at the proper depth. Do not move the sensor from side-to-side or wiggle it as it is inserted, as this could bend the tines and will form air pockets that will cause erroneous readings. In hard or rocky soils, use the Hydra Probe Jig to make pilot holes for the tines.
9. Route the sensor cable so that a drip loop is formed below the sensor.

Figure 22. Vertical cross-section showing hole dimensions and conduit, cable, and sensor placement. (TO BE INSERTED)

10. Wire the sensor to the data logger and perform a soil moisture cycle to check its operation. Initiate the cycle by connecting to the logger and changing the value of the soil moisture test variable to 1 or by selecting the soil moisture test option from the custom user menu. The cycle will occur during the next complete logger program execution interval (typically within 10 seconds).
11. Backfill the installation hole with excavated soil in reverse of the order it was removed to preserve the soil stratification, making sure to tamp the soil well. Add a few gallons of water, a little at a time between shovelfuls of soil, to help the soil settle.
12. Place a plot marker 12 inches due north of the hole center and mark the depth of the sensor on the top of the marker with a paint pen.
13. Replace the sod plug and repair the cut between the sod plug and the surrounding soil.

12 Photographic Documentation of Station Installation

Photos should be taken with a digital camera set at its highest picture quality setting. The submitted photos should be JPEG format and at least 2048 x 1536 pixels (3.2 megapixels) in size. All photos should be taken in landscape, rather than portrait, orientation. If possible, set the camera to stamp the current date in the bottom corner of each photo. The photos should be taken with enough ambient light to clearly see the subjects of interest. Avoid taking photos after sunset, before sunrise and at night. Any vehicles or equipment used during installation shall be moved so that they do not appear in any of the photos, and there shall be no people in the photos. Name the photos according to the following convention:

I_STNIDYYYYMMDDX#.jpg

where

I_ indicates a site installation photo
STNID = the 3- or 5-character station ID
YYYY = year
MM = month
DD = day of the month
X = the code given in bold type for each photo in the list below
# = number the photos if multiple views are photographed for a single item.

Note: All compass directions referred to are referenced to true north.

<u>Before Installation</u>

1. Photos from a level tripod at the center of the plot to the eight points of the compass, referenced to true north (the center of the frame should be oriented to the indicated direction to the nearest degree):
   0° = **N_**
   45° = **NE**
   90° = **E_**
   135° = **SE**
   180° = **S_**
   225° = **SW**
   270° = **W_**
   315° = **NW**

   Note: If these photos must be taken after installation is complete (e.g., due to poor lighting conditions), the camera shall be positioned such that none of the station equipment appears in any of the above photos.

2. Photo of GPS display, showing the reading taken at the center of the site plot: **GPS**

During Installation

1. Photo(s) of the tower, precipitation gauge, and solar panel mast foundation holes, before the concrete or anchoring equipment has been installed, if concrete and/or special drilling or boring is required:
    tower = **HTF**
    precipitation gauge = **HPF**
    solar panel mast = **HSF**
2. Photo showing the location of the trench for buried AC power cables, if installed = **ACT**
3. Photo of each soil moisture sensor, installed in its hole, showing the entire hole, before the hole is filled:
    5 cm = **HSM05**
    10 cm = **HSM10**
    20 cm = **HSM20**
    35 cm = **HSM35**
    50 cm = **HSM50**
4. Document deviations from the standard configuration and any other notable findings, appending logical codes of no more than 5 characters. Explain what they show in the site metadata form, referring to them by code.

When Installation is Complete

1. 4 photos taken looking toward the station, standing far enough from the station for the entire plot and tower or mast to fit in the frame, *from* the following directions, referenced to true north:
    due north = **IN**
    due east = **IE**
    due south = **IS**
    due west = **IW**
2. Photo(s) of the tower, precipitation gauge, and solar panel mast foundations, if special drilling, boring, or concrete were required:
    tower or mast = **TF**
    precipitation gauge = **PF**
    solar panel mast = **SF**
3. Photo from a position 2 feet north of each soil moisture marker, showing the filled and repaired hole with its marker and the 2-foot-by-2-foot plot centered over the sensor:
    5 cm = **SM05**
    10 cm = **SM10**
    20 cm = **SM20**
    35 cm = **SM35**
    50 cm = **SM50**

Example:

The following example indicates the proper naming of photos for Andover, ME (ANDM1), which has a mast, rather than a tower, installed on October 20, 2004, assuming it has AC power, soil moisture sensors, and required special drilling, boring, or concrete to install the mast and precipitation gauge foundations:

I_ANDM120041020N_.jpg – view to the north
I_ANDM120041020NE.jpg – view to the northeast
I_ANDM120041020E_.jpg – view to the east
I_ANDM120041020SE.jpg – view to the southeast
I_ANDM120041020S_.jpg – view to the south
I_ANDM120041020SW.jpg – view to the southwest
I_ANDM120041020W_.jpg – view to the west
I_ANDM120041020NW.jpg – view to the northwest

I_ANDM120041020HTF1.jpg – photo #1 of tower foundation hole #1
I_ANDM120041020HTF2.jpg – photo of mast foundation hole #2
I_ANDM120041020HPF.jpg – photo of precipitation gauge foundation hole
I_ANDM120041020HSF.jpg – photo of solar panel mast foundation hole
I_ANDM120041020ACT.jpg – photo of buried AC power cable trench
I_ANDM120041020HSM05.jpg – photo of 5-cm soil moisture sensor in its hole
I_ANDM120041020HSM10.jpg – photo of 10-cm soil moisture sensor in its hole
I_ANDM120041020HSM20.jpg – photo of 20-cm soil moisture sensor in its hole
I_ANDM120041020HSM35.jpg – photo of 35-cm soil moisture sensor in its hole
I_ANDM120041020HSM50.jpg – photo of 50-cm soil moisture sensor in its hole
I_ANDM120041020GNDRD.jpg – additional photo showing non-standard configuration of ground rod(s), with maintainer-chosen logical code

I_ANDM120041020IN.jpg – photo from the north of the installed station
I_ANDM120041020IE.jpg – photo from the east of the installed station
I_ANDM120041020IS.jpg – photo from the south of the installed station
I_ANDM120041020IW.jpg – photo from the west of the installed station
I_ANDM120041020TF.jpg – photo of the completed tower foundation
I_ANDM120041020PF.jpg – photo of the completed precipitation gauge foundation
I_ANDM120041020SF.jpg – photo of the completed solar panel mast foundation
I_ANDM120041020SM05.jpg – photo of the completed 5-cm soil moisture sensor plot
I_ANDM120041020SM10.jpg – photo of the completed 10-cm soil moisture sensor plot
I_ANDM120041020SM20.jpg – photo of the completed 20-cm soil moisture sensor plot
I_ANDM120041020SM35.jpg – photo of the completed 35-cm soil moisture sensor plot
I_ANDM120041020SM50.jpg – photo of the completed 50-cm soil moisture sensor plot

13 Serial Number Labeling of Sensors and Equipment

All sensors and all equipment listed in the NERON Station Metadata Form must have serial numbers assigned to them before they are installed so that they can be tracked accurately in the metadata database. However, if a sensor or unit of equipment is encountered in the field that does not have a serial number, the following convention should be used for assigning serial numbers to all equipment that do not have manufacturer-assigned serial numbers:

TTTYYMMDDSS###

where,

TTT = sub-type of equipment (see). Do not use unless shows an entry for the equipment type. Use leading zeros if the sub-type is less than 3 digits.
YY = last two digits of year that the number was assigned
MM = month of the year that the number was assigned
DD = day of the month that the number was assigned
SS = two-letter abbreviation of the state in which serial number assigned
= number in the series of the specific kind of sensor or equipment. Use leading zeros if the number is less than 3 digits

The ### part allows the assignment of serial numbers to multiple units of the same equipment or sensor type at the same time. Simply use 001 for the first, 002 for the second, etc. One sensor type or equipment type can have the same serial number as a different type of sensor or equipment, since each unit of equipment is always referred to in the metadata database by both its equipment type and serial number. The only requirement is that sensors or equipment of the same type have unique numbers. Equipment with different sub-types are considered different types and can be assigned identical YYMMDDSS### portions of their serial numbers.

Table 7. Entries to use for the equipment sub-type portion when assigning a serial number to a sensor or unit of equipment.

Equipment Type	TTT
Solar Panel	Rating in watts
Battery	Amp-hour rating

Every sensor, except for barometers, should be labeled such that its serial number is printed on the cable end that is connected to the logger. The serial number should be printed on light-colored heat-shrink tubing, with an additional layer of clear heat-shrink tubing over the serial numbers to prevent them from being rubbed off or obscured. Sub-surface sensors that do not have their serial numbers stamped or etched on the sensor heads should have an additional label at the sensor end of the cable.

Every sensor or unit of equipment that is not installed inside an enclosure should have its serial number etched on its body, if possible. If the serial number is just printed on the body by the manufacturer or the manufacturer did not assign a serial number, then the installer should etch the serial number on an available non-sensitive surface. If etching is not possible, then the serial number should be printed on the cable, as described above. This will prevent problems with tracking sensors and equipment whose serial numbers have become unreadable due to weathering.

The following examples indicate the proper assignment of serial numbers to equipment, when assigned in Tennessee on June 7, 2005:

First 84 amp-hour battery of the day to be numbered – 084050607TN001
First 26 amp-hour battery of the day to be numbered – 026050607TN001
First 50W solar panel of the day to be numbered – 050050607TN001
Second 50W solar panel of the day to be numbered – 050050607TN002
First air temperature sensor of the day to be numbered – 050607TN001
Second air temperature sensor of the day to be numbered – 050607TN002
First precipitation gauge base of the day to be numbered – 050607TN001

14 Submission of Documentation

All forms and photos documenting site installation should be submitted to the NERON Project Office within 5 business days after completing the installation. Electronic versions of the metadata form, mass install form, installation issues document, site visit data verification, and GEONOR precipitation gauge calibration sheet, which include provision for entering all required information electronically, will be supplied to the maintenance contractors. These forms must be submitted in the electronic, fillable format; scanned versions will not be accepted. When scanning the installation checklist, as-built drawing, obstruction drawing, site acceptance checklist, and NEPA statement for submission, they should be scanned at 300 dpi in grayscale mode and submitted in JPEG format. All documentation should be submitted to the NERON Project Office in electronic form by FTP to the following address:

ftp://isos.noaa.gov

Each user must use the username and password supplied by the NERON Project Office to ensure access to the correct directory in the FTP site. Forms and the collected logger variable data file should be uploaded to the directory corresponding to the state in which the station is located within the "submitted_forms" directory. Photos should be uploaded to the directory corresponding to the state in which the station is located within the "submitted_photos" directory.

Whenever documentation is submitted to the FTP site, send an email notification to the NERON QA manager so that the metadata database can be updated as soon as possible.

Use the following naming convention for all forms submitted to the FTP site, except for precipitation gauge calibration forms, whose convention will be explained below:

I_STNIDYYYYMMDDFT.xxx

where

STNID = the 3- or 5-character station ID
YYYY = year installation completed
MM = month installation completed
DD = day of the month installation completed
FT = form type (see below)
xxx = document extension (e.g., doc, pdf, jpg)

Table 8. Entries to use for the form type portion of an electronic form name and required submission format.

Form	FT	Required Format
Installation Checklist	CL	Scanned
Metadata Form	MD	Electronic Form
Mass Install Form	MI	Electronic Form
As-Built Drawing	AB	Scanned
Obstruction Drawing	OD	Scanned
Installation Issues Document	II	Electronic Form
Site Visit Data Verification	DV	Electronic Form
Site Acceptance Checklist	SA	Scanned
NEPA Statement	NS	Scanned

Use the following naming convention for precipitation gauge calibration forms:

EQTYPE_SN_YYYYMMDD.xxx

where,

EQTYPE = the equipment type of the unit being calibrated (VIBRATING_WIRE for a GEONOR gauge; PRECIP_GAUGE for a weighing bucket gauge where the weighing mechanism is an integral part of the gauge; PRECIP_SENSOR where the weighing mechanism is a separate unit other than a vibrating wire)
SN = the sensor serial number
YYYY = year of calibration
MM = month of calibration
DD = day of calibration
xxx = document extension (which should be "xls" in most cases)

Example:
The following example indicates the proper naming of documentation for Andover, ME (ANDM1), which was installed on October 20, 2004:

I_ANDM120041020CL.jpg – installation checklist
I_ANDM120041020MD.doc – metadata form
I_ANDM120041020MI.doc – mass install form
I_ANDM120041020AB.jpg – as-built drawing
I_ANDM120041020OD.jpg – obstruction drawing
I_ANDM120041020II.doc – installation issues document
I_ANDM120041020DV.doc – site visit data verification
I_ANDM120041020SA.jpg – site acceptance checklist
I_ANDM120041020NS.jpg – NEPA statement
VIBRATING_WIRE_69304_20041020.xls – GEONOR calibration sheet for wire 1
VIBRATING_WIRE_71004_20041020.xls – GEONOR calibration sheet for wire 2

VIBRATING_WIRE_71104_20041020.xls – GEONOR calibration sheet for wire 3